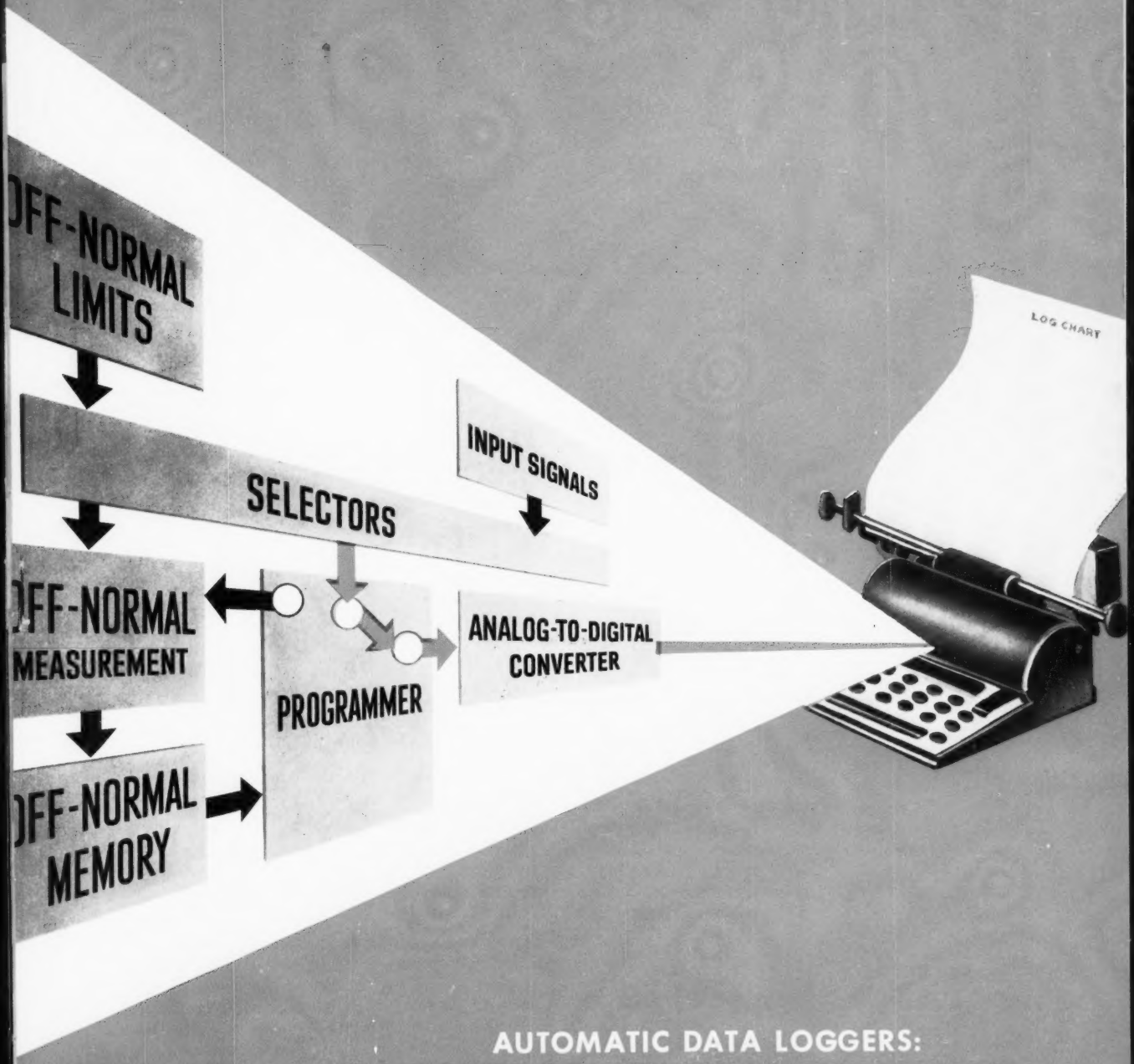
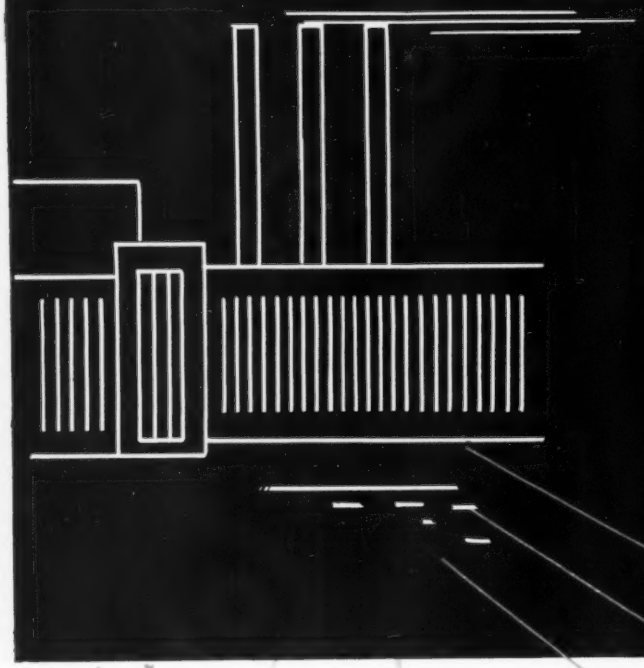
75th Year of advancing the power services

Power

APRIL 1957
ONE DOLLAR
A McGRAW-HILL PUBLICATION



AUTOMATIC DATA LOGGERS:
New approach to power-plant control ► 73

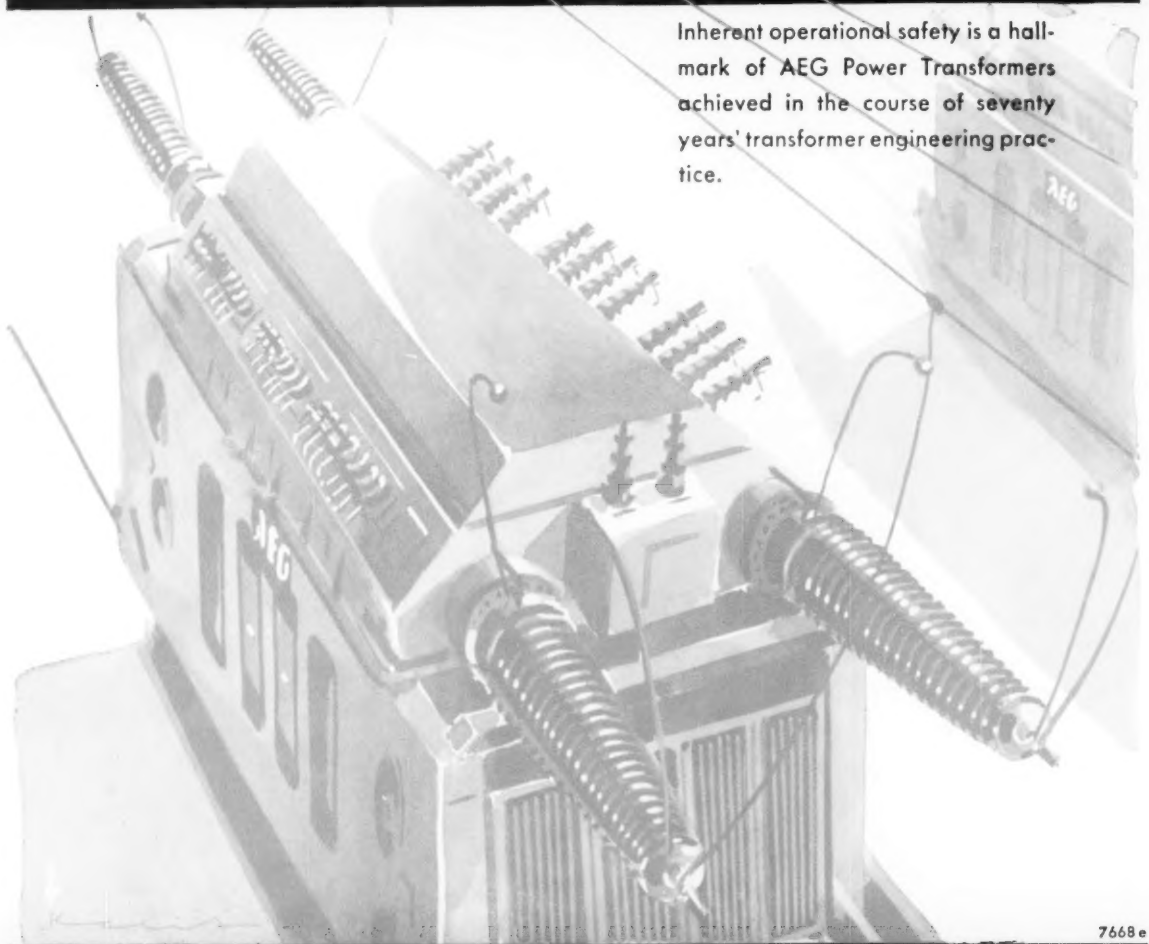


AEG

Electrical Engineering

The AEG supply transformers for all operating conditions to all countries of the globe. AEG Power Transformers have low losses and low weight for their output. AEG on-load tap-changers distinguish themselves by their reliable and robust design.

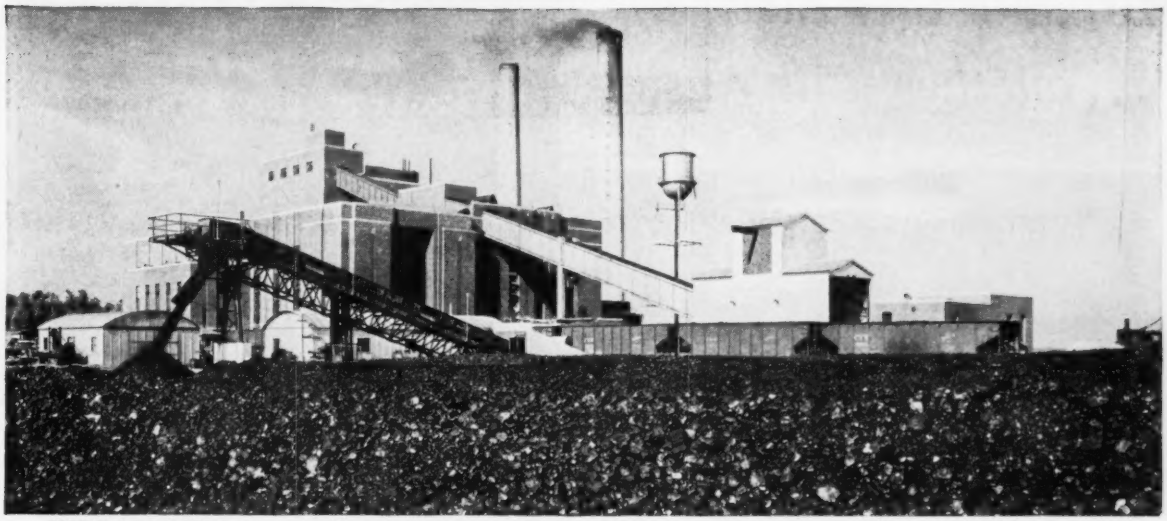
Inherent operational safety is a hallmark of AEG Power Transformers achieved in the course of seventy years' transformer engineering practice.



7668e

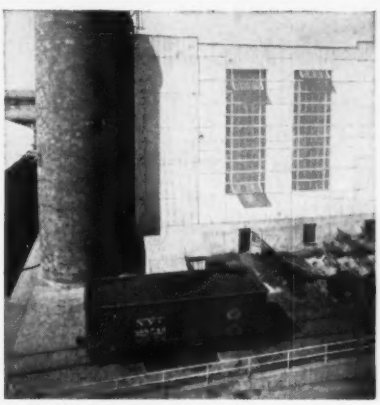
ALLGEMEINE ELEKTRICITÄTS-GESELLSCHAFT

Berlin (West) EXPORT DEPARTMENT Frankfurt (Main)



RECENTLY ENLARGED BY ⅔, this Midwest power plant underwent minimum rearrangement. Coal distribution equipment was extended to serve new bunkers as well as original Link-Belt system installed in 1931. Stacker in yard piles 30,000-ton reserve.

12-HOUR CHANGEOVER to fuel two additional generating units was accomplished in revamping this coal handling system.



SMALL PLANTS restricted in area get expandability plus efficient utilization of initial equipment from Link-Belt designs.

BOOK 2410 has complete data on Link-Belt coal handling equipment plus tested layouts of large and small systems.

Coal handling has room to grow

when Link-Belt provides for low-cost expansion of capacity in both large power plants and small boiler houses

THE growth of populations and industry usually demands provision for coal handling expansion in the initial plans of power stations and boiler houses. Link-Belt has helped meet that need, with consideration for location, transportation facilities, reserve storage needs and other special problems.

With its broad line of equipment, Link-Belt offers a single source for feeders, elevators, conveyors, stackers—whatever you need for lowest per-ton handling costs. In addition, Link-Belt engineering can adapt the lessons taught by thousands of installations to your individual requirements.

Working with your consultants, Link-Belt is equipped to accept full responsibility for design, fabrication, erection and satisfactory performance of your entire system. Or, if you need only a single conveyor, call your nearest Link-Belt office for prompt, expert service.

14.097

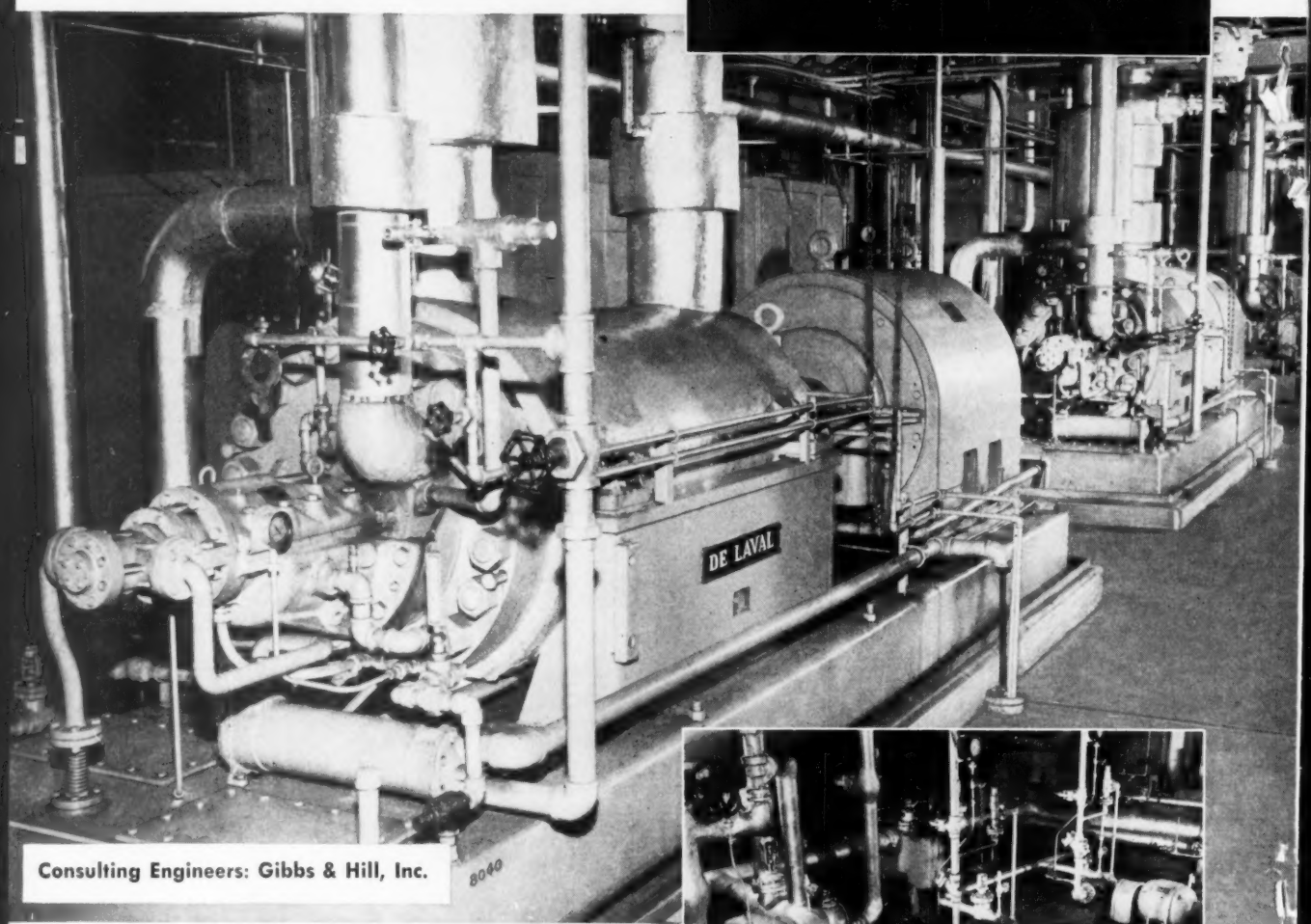
LINK-BELT

COAL HANDLING EQUIPMENT

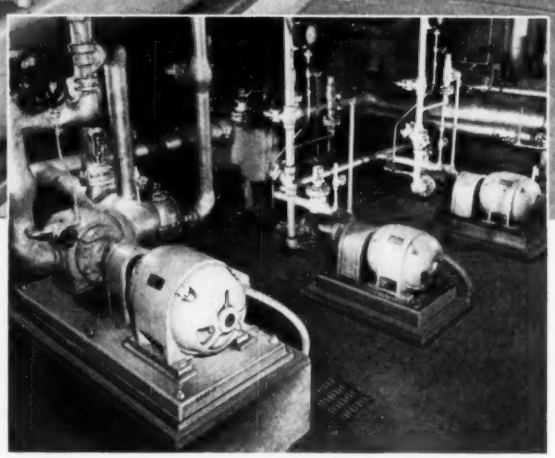
LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.

Atlantic City Electric ... another utility using

DE LAVAL
BARREL TYPE BOILER FEED PUMPS



Consulting Engineers: Gibbs & Hill, Inc.



De Laval IMO rotary positive displacement pumps handle heavy fuel oil. They are used for standby operation.

Atlantic City Electric Co. and Gibbs & Hill, Inc., Consulting Engineers, know that they can count on De Laval reliability. That's why they selected three De Laval high pressure barrel type boiler feed pumps for the Deepwater Station in Penns Grove, New Jersey. These 10-stage units deliver 675 gpm, operating at 1762 psi with temperature at 287 F. The pumps are driven by 900 hp motors.

De Laval barrel type boiler feed pumps operate at pressures up to 5500 psi. These units offer many important design advantages, such as double volute diaphragm, individual diaphragm bolting, only one inner high-pressure joint, and bare shaft construction. Their dependability is proven by year in, year out service in public utilities and industrial plants.

Send for De Laval Bulletin 1506, which contains helpful data.

DE LAVAL *Boiler Feed Pumps*

DE LAVAL STEAM TURBINE COMPANY
815 Nottingham Way, Trenton 2, New Jersey

Power

APRIL 1957 • VOLUME 101 NUMBER 4

ENGINEERING AND MANAGEMENT

Automatic data logging—A step closer to the automatic plant ... 73
Here's how to meet today's challenge of nuclear corrosion ... 80
Network distribution: No. 8 in the PTG . . . *electrically* series ... 82
Delaware City—First station designed to burn fluid coke ... 86
Calculate electric heater wattage this easy way ... 90
Save dollars by selecting most economic insulation thickness ... 92
Nuclear notes: News of latest developments ... 95
Simple energy equation of gases: Thermo refresher No. 7 ... 96
Series turbocharging for 2-cycle engines ... 99
Argonne's Experimental Boiling Water Reactor goes on the line ... 100
Specify standard electrical equipment to hold cost down ... 102
Data sheet: Schedule-40 piping cross sections ... 105

PLANT OPERATION AND MAINTENANCE

Today, wool felt does many plant jobs for you ... 109
Ultrasonic inspection locates cracked turbine bolts ... 112
Positive method of measuring vacuum-system air leakage ... 114
Diesel cooling water needs treatment to combat corrosion ... 116
Let's take a look at the sliding-vane compressor ... 118
Why h-v air-conditioning system sometimes develop snags ... 120
Use the right tools to cut boiler-tube repair costs ... 122
These three lubrication tips help keep steam engines running ... 124
How to maintain switches mounted with transformers ... 126
Fact file: Six tips on storage-battery care ... 128
Practical ideas ... 130
Plant problems ... 136
Arguments ... 142
How-to: Electric hammer ... 144
Basics: Dc generators ... 146
Marmaduke Surfaceblow ... 148

READER SERVICE SECTION

This month's service index ... 152
Reports from the field ... 154
Technical briefs ... 156
Plant equipment news ... 160
New free literature ... 169
George Edwards ... 172

Print order this issue: 48,980

AUTOMATIC DATA LOGGER, depicted in simplified form on this month's cover, is the first to go into a U.S. central station. Built by Panellit, it's on line at Gulf States' Neches Station, Beaumont, Texas.

The logger represents a sharp departure from manually logged data. And Neches engineers are already realizing impressive gains. In fact, centralized info systems of this kind may well mark the start of a new era in power-plant controls. Timely roundup of subject begins on page 73.

Next month . . .

Belts and chains, old friends of the plant engineer, are spotlighted in up-to-minute staff report. New materials, fresh application tips make this 20-p feature "must" reading.

Corona testing is getting recognition as a preventive maintenance procedure. Modern equipment makes field testing simple, safe. And the trend toward higher voltages, smaller unit space, dry insulations, increases importance of corona tests. Watch for this fact-filled 2-pager.

Package boilers demand high-quality water. But what treatment methods are best? How do you prevent scale and deposits? Why are dissolved gases in water important? May Q&A has solutions to these and many other problems on feedwater treatment.

. . . and a future month

Fuel engineer, in true sense of the word, is a consultant who's up on fuel characteristics, combustion problems, firing equipment, furnace needs. Future article tells how you can benefit more from his know-how.

POWER (with which are consolidated *Science and Industry, The Engineer Review, The Engineer, The Stationary Engineer* and *Operating Engineer*) is published monthly by McGraw-Hill Publishing Company, Inc. James H McGraw (1860-1948), Founder. PUBLICATION OFFICE: McGRAW-HILL BUILDING, 330 W 42nd St, New York 36, N. Y.

EXECUTIVE, EDITORIAL and ADVERTISING OFFICES: 330 W 42nd St, New York 36, N. Y. Donald C McGraw, President; Joseph A Gerardi, Executive Vice-President and Treasurer; John J Cooke, Secretary; Nelson Bond, Executive Vice-President, Publications Division; Ralph B Smith, Vice-President and Editorial Director; Joseph H Allen, Vice-President and Director of Advertising Sales; A R Venezian, Vice-President and Circulation Coordinator.

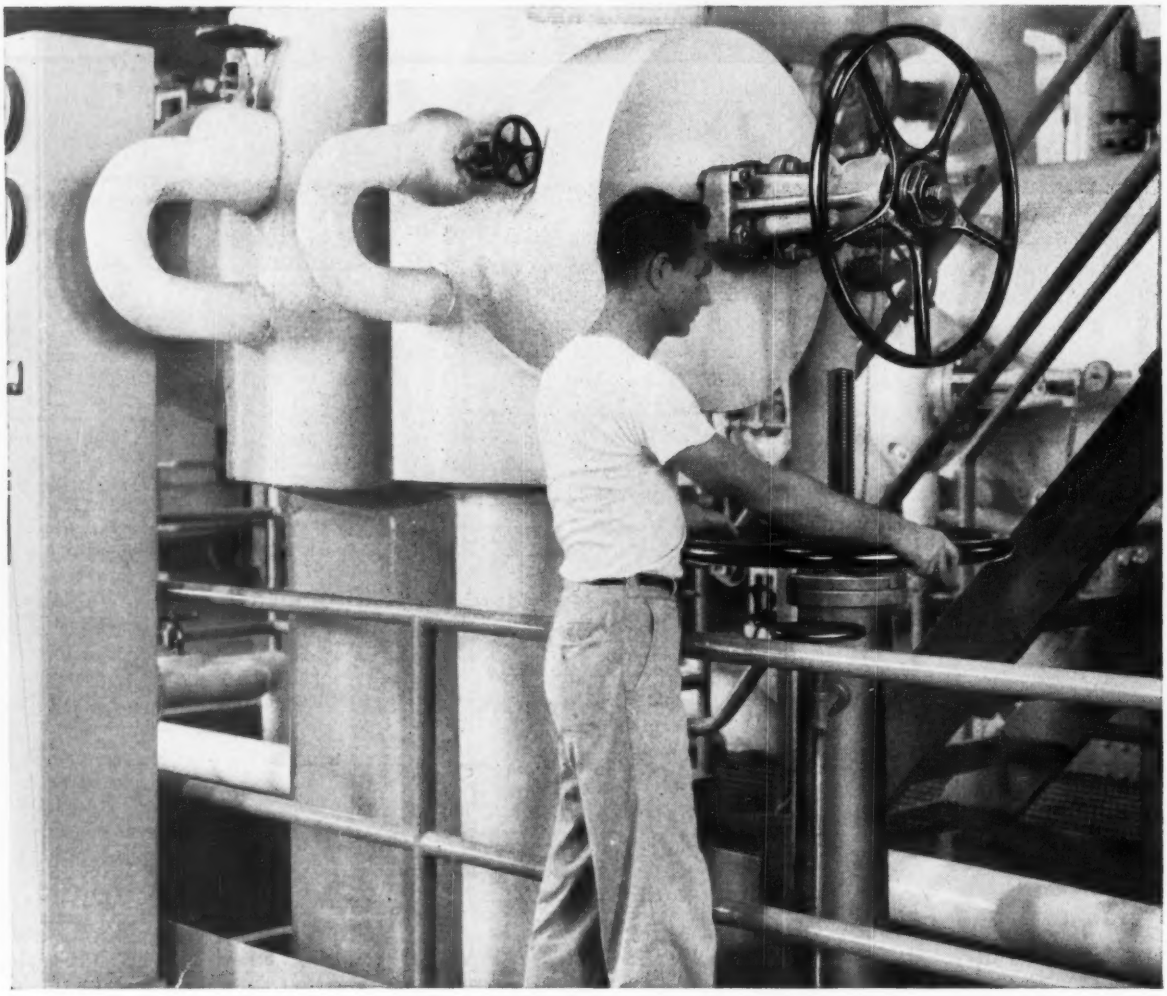
SUBSCRIPTIONS: Address correspondence to POWER, Subscription Service, 330 W 42nd St, New York 36, N. Y. Allow one month for change of address. Subscriptions are solicited only from executives, engineers and supervisory personnel engaged in design, operation and maintenance of power, light, heat and other plant services in utilities, construction firms, industrial and service plants. Position and company connection must be indicated on subscription orders.

Single copies: U. S. and possessions, Canada $1.00; all other countries $1.50. Subscription rates—U. S. and U. S. possessions: $4.00 for one year, $6.00 for two years, $8.00 for three years. Canada: $6.00 for one year, $9.00 for two years, $12.00 for three years. All other countries: $15.00 for one year, $25.00 for two years, $30.00 for three years. Second-class mail privileges authorized at New York, N. Y. Printed in U. S. A.

©Copyright 1957 by McGraw-Hill Publishing Company, Inc. All rights reserved.

POWER articles are indexed in both the *Industrial Arts Index* and the *Engineering Index*. POWER publishes its own annual index.

How Crane Steel Valves Cut Power Piping Costs



Everything's O.K. below—since 1942

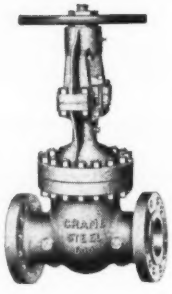
Always smooth, always positive in action—says the operator of this Crane 10-inch, 600-pound steel gate valve with extension yoke . . . and never a sign of leakage at the seats or bonnet joint.

That's the way this valve has performed for 15 years—since it was installed in a main steam cross-over line in the Nueces Bay Station of Central Power & Light in Corpus Christi. It's on working pressure of 400 psi at 830 deg. F.

The cost-in-service record of the valve is clean. It has not been touched by a mechanic except for ordinary routine servicing. Indications are it will remain in the line for a long time to come.

Unusual performance? Not for Crane steel valves. They're famous for cutting power piping costs. They're better suited for such service because of quality castings made in Crane's own foundry—with closely controlled heat-treating techniques . . . exacting machining, assembling and testing procedures that are unique with Crane.

You can be sure of low-cost steel valve performance when you specify Crane. Get all the facts from your Crane Representative or write to the address below.



CRANE VALVES & FITTINGS

PIPE • PLUMBING • KITCHENS • HEATING • AIR CONDITIONING

Since 1855—Crane Co., General Offices: Chicago 5, Ill.—Branches and Wholesalers in All Areas

speaking of **Power**

Meetings with writing editor, then conferences with staffers Marschalek and Thornton help Howie Kallen dig in as . . .

Special Projects editor: Another step up the ladder for Kallen

L N ROWLEY *Editor*

B G A SKROTZKI *Engineering and Management*
S M ELONKA *Operation and Maintenance*
H P KALLEN *Special Projects*
J J O'CONNOR *Managing Editor*
R C BELLAS *Assistant Editor*
R H MARKS *Assistant Editor*
N PEACH *Assistant Editor*
A P SOMMER *Assistant Editor*
A S THORNTON *Assistant Editor*
C F MARSCHALEK *Art Editor*
F A ANNETT *Contributing Editor*

P W SWAIN *Consulting Editor*

DOMESTIC NEWS BUREAUS: *Atlanta, Cleveland, Detroit, Dallas, San Francisco, Washington*

WORLD NEWS OFFICES: *London, Paris, Bonn, Tokyo, Beirut, Rio de Janeiro, Mexico City*

SHELTON FISHER *Publisher*

CLARK BOUGHTON *Sales Manager*

DISTRICT MANAGERS

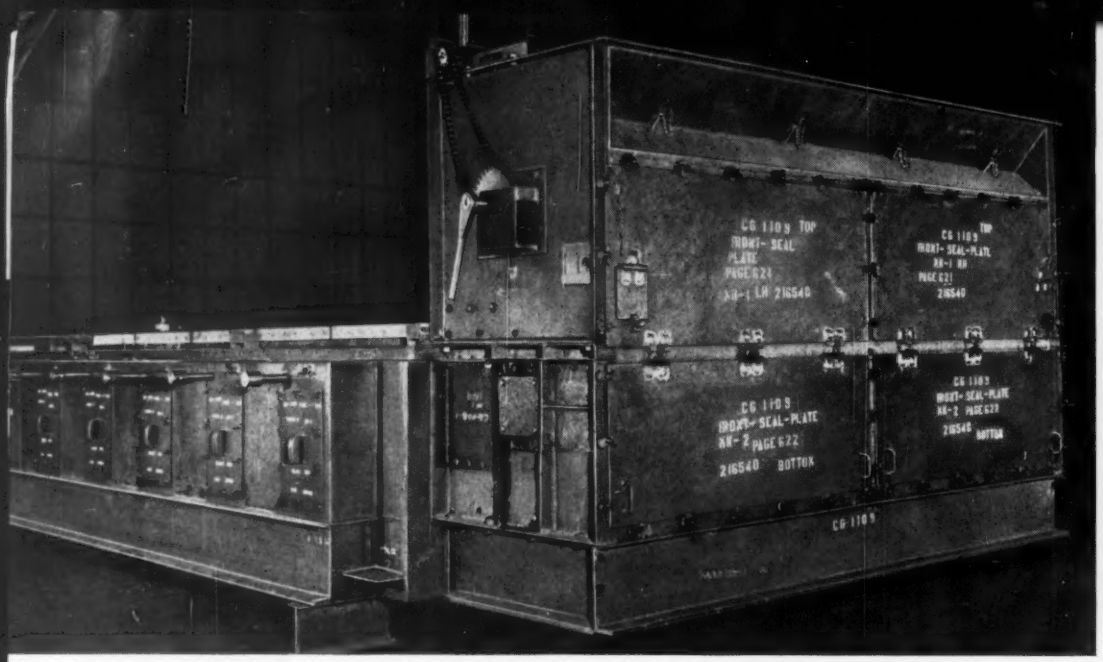
W R KLEIN, 330 W 42nd St, New York 36, N. Y.
J E DEAN, 330 W 42nd St, New York 36, N. Y.
C R LONG, Architects Bldg, Philadelphia 3, Pa.
L W ROMIGH, 520 N Michigan Ave, Chicago 11, Ill.
W K PONDER, 1510 Hanna Bldg, Cleveland 15, Ohio
G L CRANE, Continental Bldg, St. Louis 8, Mo.
M H MILLER, 801 Rhodes-Haverty Bldg, Atlanta 3, Ga.
D C BILLIAN, The Vaughn Bldg, Dallas 1, Texas
R C ALCORN, 68 Post St, San Francisco 4, Calif.
H L KEELER, 1125 W Sixth St, Los Angeles 17, Calif.

When Editor Lou Rowley announced to the staff that the Special Projects chair was going to Associate Editor Howie Kallen, the general reaction was that this tough assignment was entering most capable hands.

What's a special project? For some 22 years POWER readers have grown to expect periodical staff-written reports covering specific areas within the power-service framework. First such report, *Piping*, was published in the February 1936 issue. The latest, *Belts and Chains*, is now being polished off by Assistant Editor Althea Thornton for the May issue. Over this span of almost a quarter century, staff-written special reports have become a sort of POWER trademark. And with the fast-expanding technical needs of POWER readers to be met, these reports will get even greater emphasis in the future. Then, as now, the staff report will prove the practical answer to the problem of keeping busy power-service engineers updated on fast-moving technology.

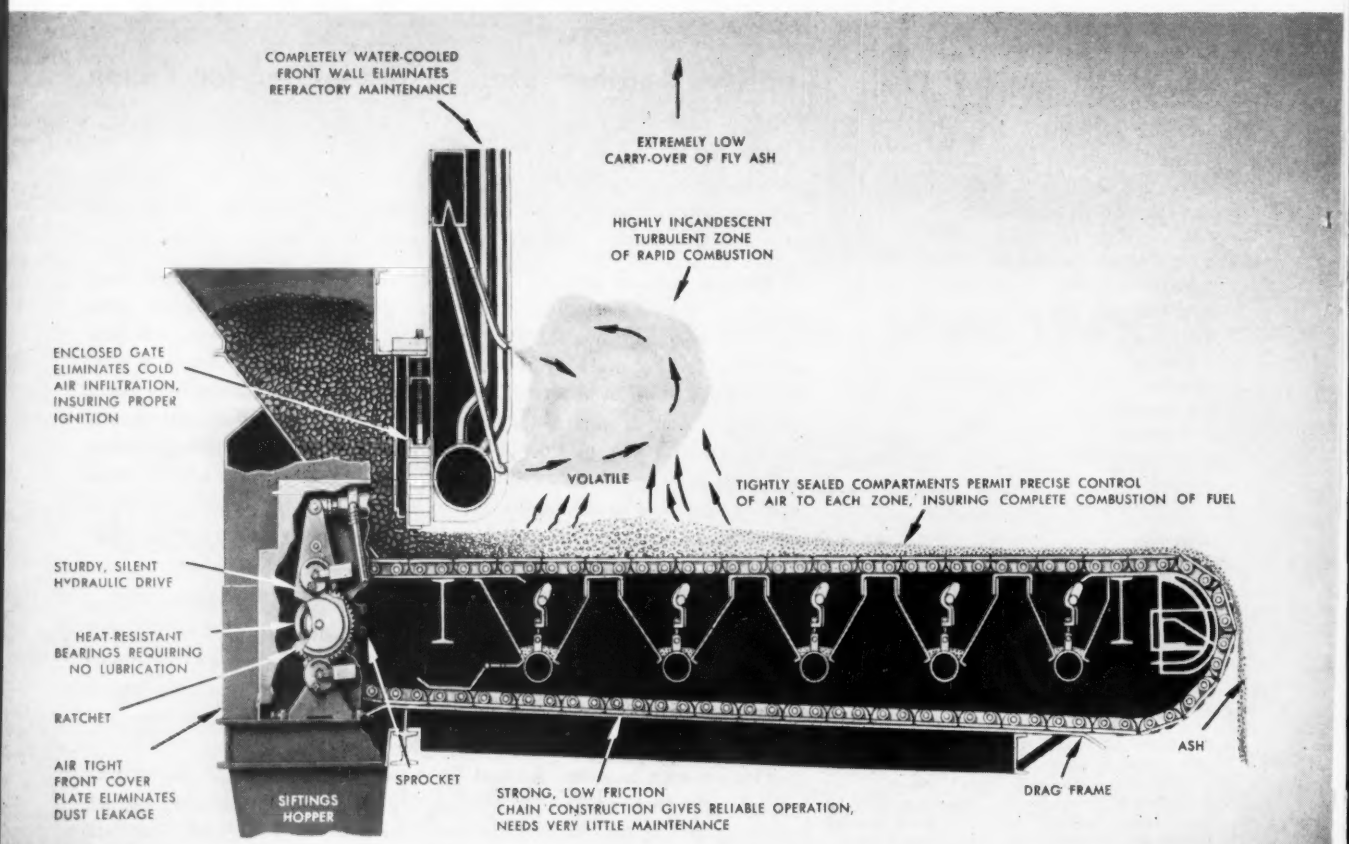
Responsibilities of the Special Projects editor run all the way from early planning to final production. He plays a leading part in the staff discussions that select topics for future reports. Then, when a given report is assigned, he works closely with the "writing" editor to develop a logical outline and to plan the research, which always includes interviews and correspondence with specialists in the field.

Finally, with technical data at hand, the SP editor helps the writing editor in the tremendous job of winnowing the mass of available material, readying it for the conferences with Art Editor Marschalek that will determine the visual presentation. Thus, from idea to finished report, the SP editor plays a vital coordinating role.

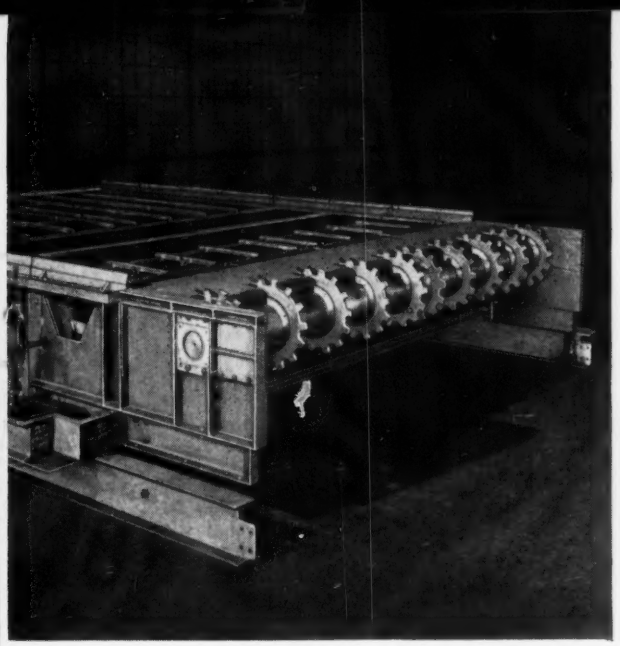


Front of unit is air and dust-tight, maintaining a clean stoker area. Note front seal plates.

B&W Jet-Ignition Stoker Selected


COMPLETELY WATER-COOLED FRONT WALL ELIMINATES REFRACTORY MAINTENANCE
EXTREMELY LOW CARRY-OVER OF FLY ASH
HIGHLY INCANDESCENT TURBULENT ZONE OF RAPID COMBUSTION
ENCLOSED GATE ELIMINATES COLD AIR INFILTRATION, INSURING PROPER IGNITION
VOLATILE
TIGHTLY SEALED COMPARTMENTS PERMIT PRECISE CONTROL OF AIR TO EACH ZONE, INSURING COMPLETE COMBUSTION OF FUEL
STURDY, SILENT HYDRAULIC DRIVE
HEAT-RESISTANT BEARINGS REQUIRING NO LUBRICATION
RATCHET
AIR TIGHT FRONT COVER PLATE ELIMINATES DUST LEAKAGE
SIFTINGS HOPPER
SPROCKET
STRONG, LOW FRICTION CHAIN CONSTRUCTION GIVES RELIABLE OPERATION, NEEDS VERY LITTLE MAINTENANCE
ASH
DRAG FRAME

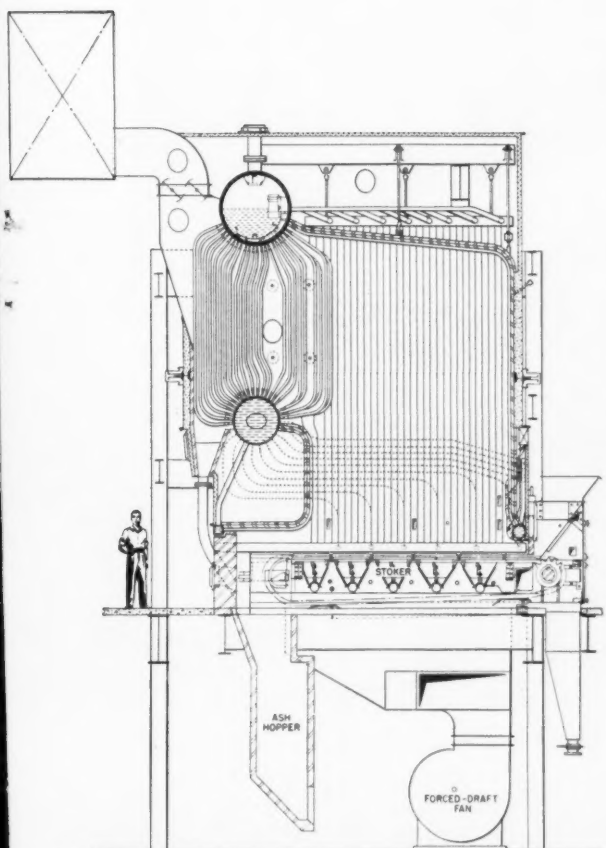
This is Jet-Ignition: Volatile matter, distilled off as coal enters furnace, is immediately mixed with high pressure air. Turbulence insures rapid combustion, radiates heat down on incoming fuel. Gate is completely enclosed, assuring ignition stability. Inspection is easy, maintenance low.



Jet-Ignition Stoker is designed on the chain-grate principle. It has simple, compact hydraulic drive.

Latest Unit at University of Rochester Will Burn High-Caking Coals

to Solve Smoke and Fly Ash Problems



B&W Stirling Boiler with Jet-Ignition Stoker at University of Rochester, designed for 100,000 lbs of steam per hr at 125 psi.

Stable, efficient combustion over wide load ranges, without smoke and with extremely low fly ash, is achieved by the new B&W Jet-Ignition Stoker when burning bituminous and sub-bituminous coals—including high-caking and coking grades. The Jet-Ignition Stoker maintains a clean stack without using dust collectors.

Selection of a B&W Jet-Ignition Stoker for the University of Rochester was made to solve a community relations problem caused by smoke and fly ash. Dr. Lewis D. Conta, Chairman of the University's Division of Engineering, and George D. Haas, Chief Engineer, recommended installation of the unit after observing a commercial installation burning the high-caking coals used by the University.

B&W Jet-Ignition Stokers are another of the developments of B&W engineering and research, supported by nearly a century of experience in all phases of steam generation. If your problem is one of excessive smoking and fly ash emission, Bulletin G-85 will tell you how a B&W Jet-Ignition Stoker can help you. And for any problem in steam generation, B&W engineers are ready to help you and your engineers find the solution. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

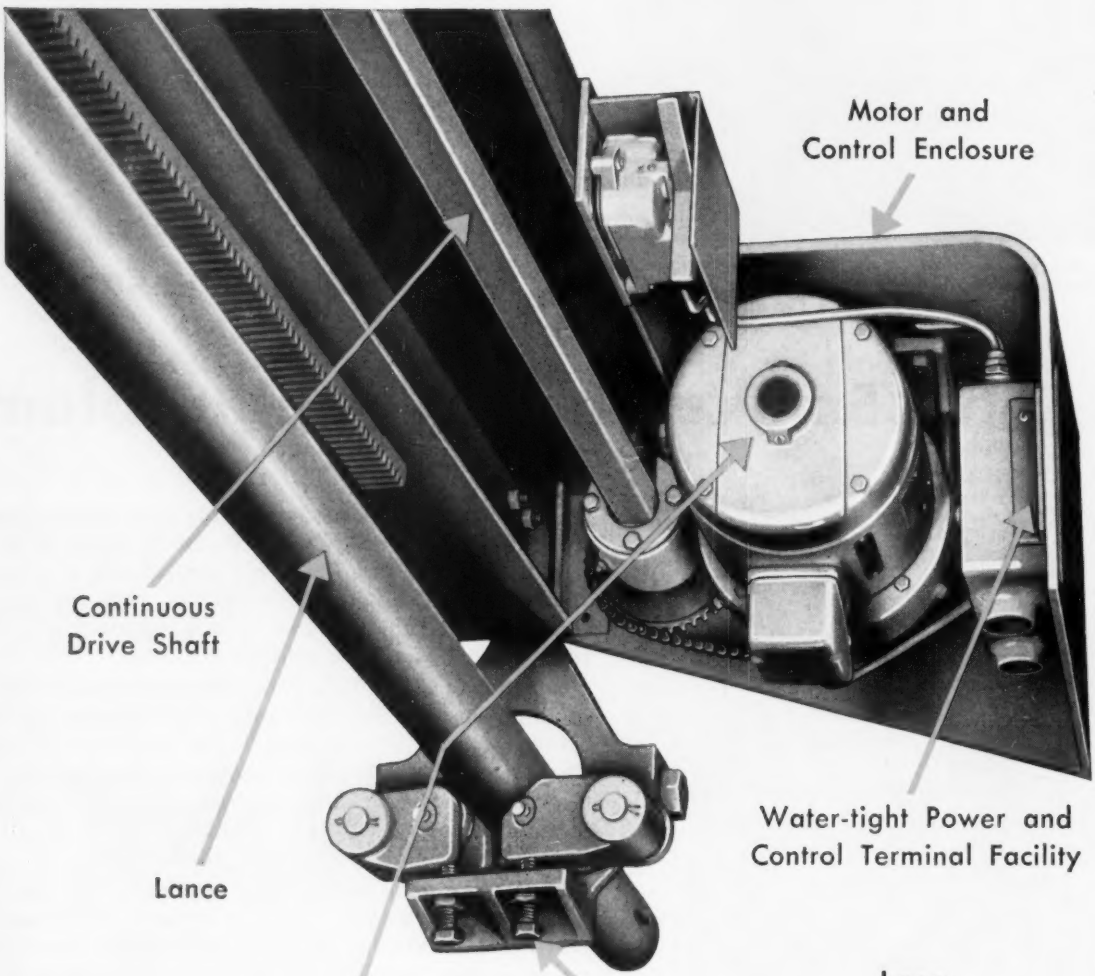
G-831-18

BABCOCK & WILCOX

B&W

BOILER DIVISION

FRONT END



Single Enclosed Motor for both
propulsion and rotation
Motor mounted at boiler end for improved
accessibility and better protection from
physical damage and elements.
(Outboard end motor mounting optional)

Single-Motor DRIVE

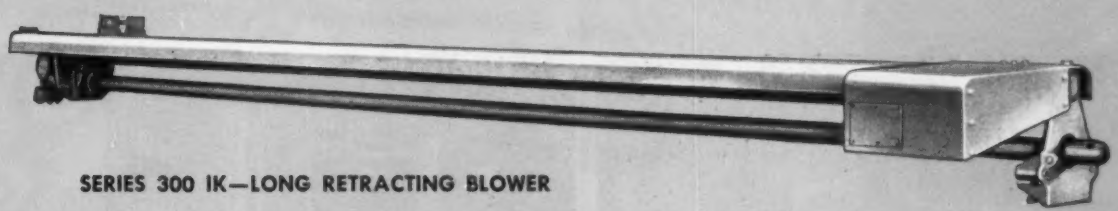
another important feature of

New Diamond

Series 300 IK
LONG RETRACTING BLOWER

As illustrated at the left, only *one motor* is used to simultaneously propel and rotate the lance tube of the new Series 300 IK. The motor is stationary and is mounted at the boiler wall for easier accessibility and greater protection from physical damage and the elements (note the protective enclosure). This front end single-motor drive is simple and dependable. There is only *one* set of motor elements . . . *one* set of control elements . . . and *one* set of power supply facilities to operate and maintain.

Additional important features of the new Series 300 IK are listed in the panel below. Check them and you will understand why this blower is establishing a new standard of efficiency, economy and dependability in cleaning those heating surfaces that require a long retracting blower. For further information about the new Series 300 IK, ask your local Diamond office or write directly to Lancaster for Bulletin 2111 U.



SERIES 300 IK—LONG RETRACTING BLOWER

OTHER ADVANTAGES OF SERIES 300 IK BLOWERS

- Backbone and Protective Cover
- Compact, Accessible Electric Power and Control Terminal Facilities
- Nozzle-Sweep-Every-Inch Cleaning Pattern
- Improved "Type A" Nozzle
- Positive Gear Carriage Drive
- Poppet Valve with Adjustable Pressure Control
- Positive Mechanically Operated Valve
- Single Point Outboard Suspension
- Oversize Lance (Step-Tapered for Extra Long Travel)
- Auxiliary Carriages for Extra Long Travel
- Designed for Quick, Easy Servicing

No other blower gives you all these advantages.

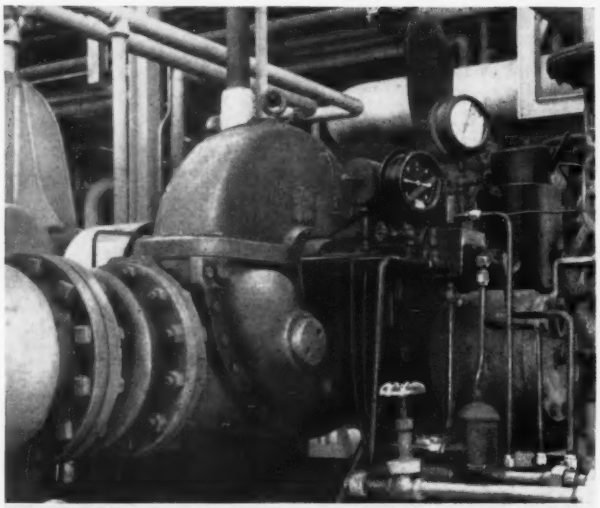
Diamond **DIAMOND POWER SPECIALTY CORPORATION**

LANCASTER, OHIO

Diamond Specialty Limited
Windsor, Ontario

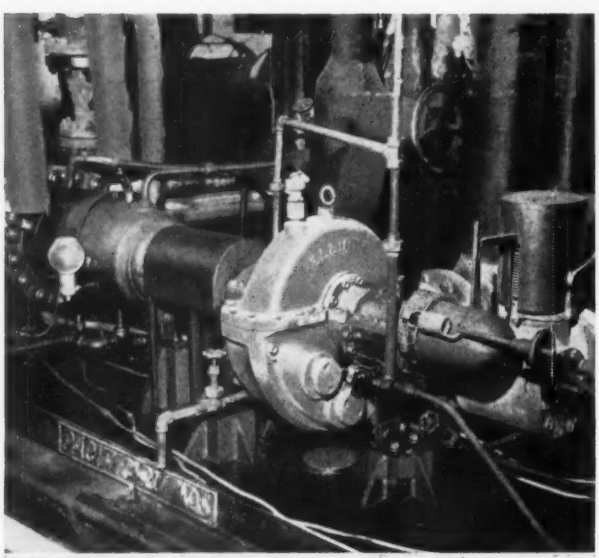
7739

ELLIOTT serves

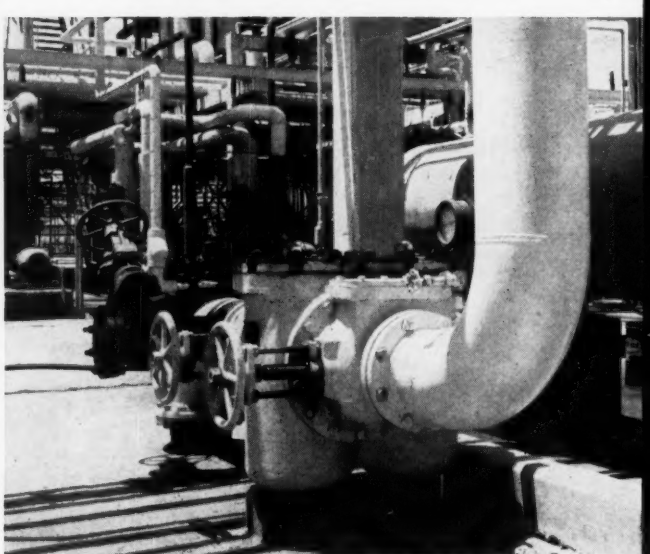


This Elliott 370-hp, 3240-rpm steam turbine drives a reciprocating compressor through a gear. The compressor serves a hydroformer unit.

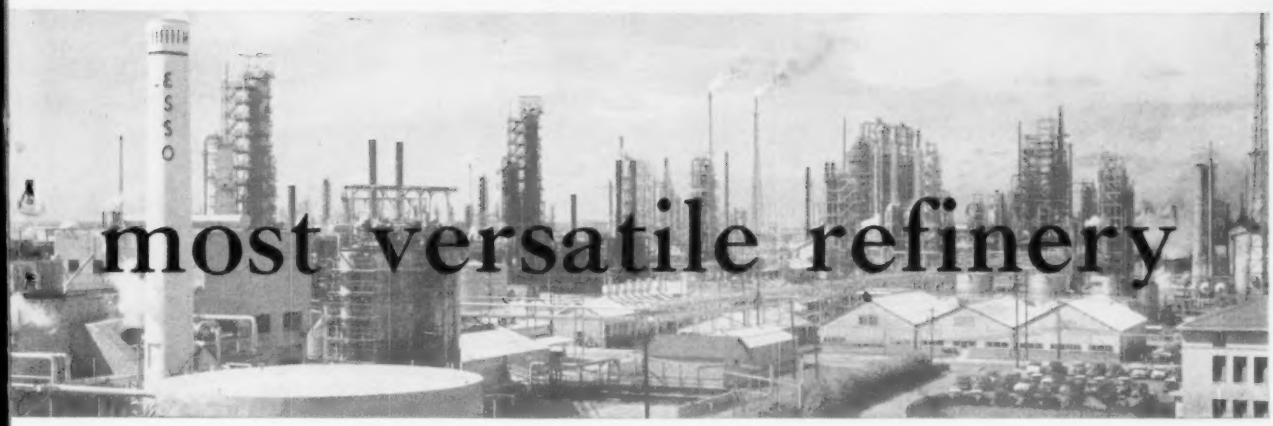
These two Elliott 450-hp weather-protected outdoor motors, located in the bluff area near the docks, are used to drive centrifugal pumps which handle heavy naphtha from adjacent tankage.



One of eleven Elliott turbines driving centrifugal pumps at a lube oil unit.



Here an Elliott 8-in. twin strainer handles river water at a lube oil unit.



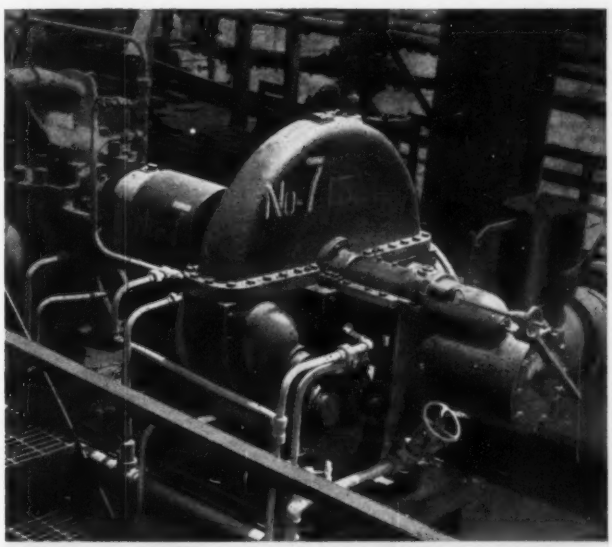
most versatile refinery

Esso Standard's Baton Rouge Refinery—producing more products than any other—is served by Elliott Turbines, Motors, Twin Strainers, Steam Ejectors, Deaerating Heaters

When this Esso Standard Oil Company refinery started operations in 1909, it processed 2000 barrels of crude oil per day into only three products. Now it converts 340,000 barrels of crude oil per day into over 600 products—a world's record in respect to number of products. It is also rated the largest refinery in the United States based on crude running capacity.

More than 100 Elliott steam turbines, ranging in size from 7 to 900 hp, are used in this refinery to drive all sorts of pumps, fans and compressors. Over a score of Elliott twin strainers, sizes 2 in. to 24 in., and Elliott steam jet ejectors serving vacuum units have been installed. Elliott 300-hp, 400-hp, and 450-hp motors are driving pumps and an Elliott 1750-hp, 1800-rpm induction motor is driving a centrifugal gas compressor. There are also four Elliott deaerating feedwater heaters.

Here is another dramatic illustration of how highest-quality steam and electrical products, manufactured by Elliott, serve leading industries. For information on how Elliott products can help you, call your nearby Elliott District Office or write Elliott Company, Jeannette, Pa.

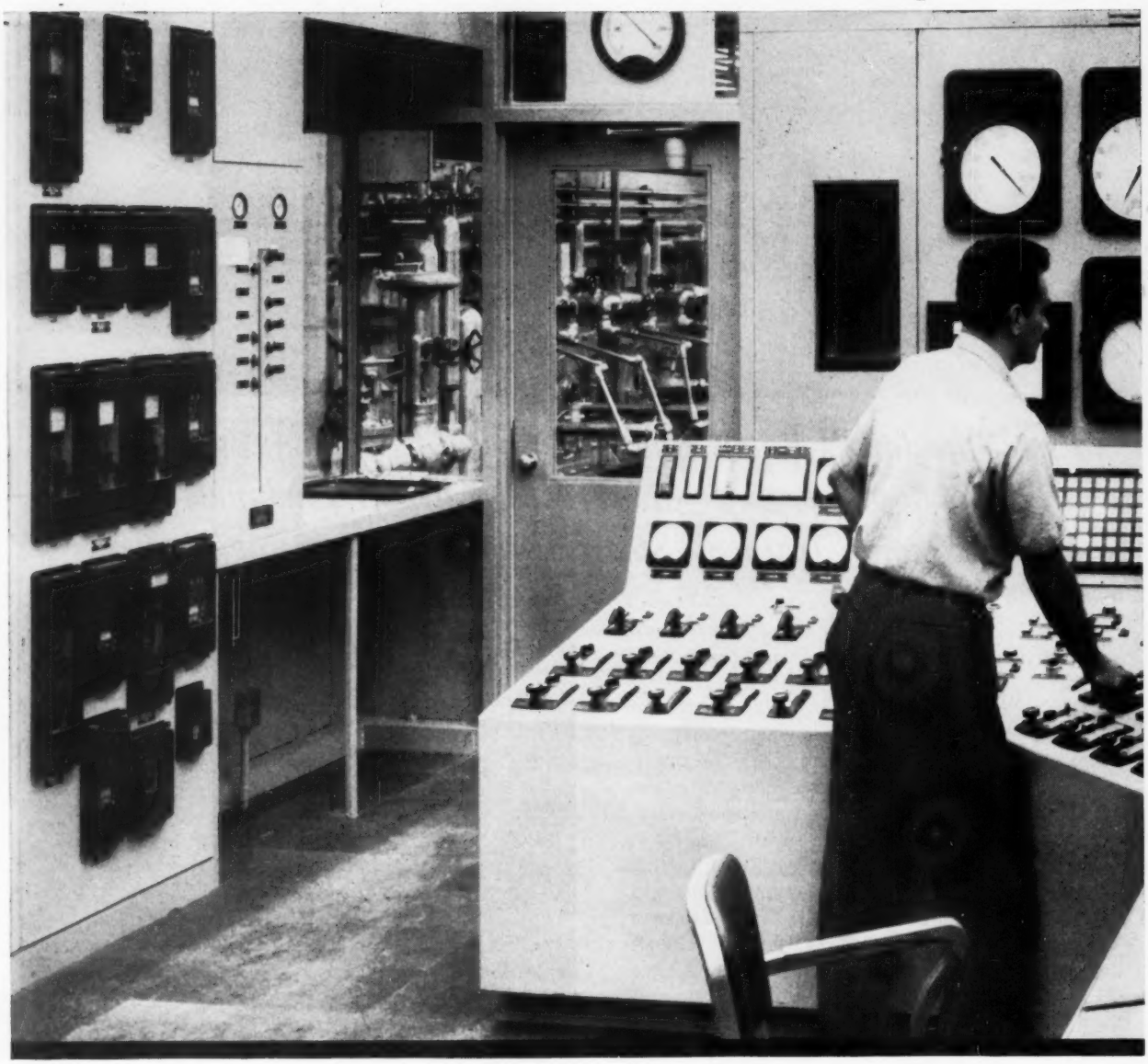


Elliott Turbines, **from small single-stage to large multi-stage types, assure highest-quality, long-term continuous service. This typical installation, operating on a 24-hour-a-day basis, is a 460-hp, 1750-rpm Elliott turbine which drives a river water booster pump. Bulletin H-22B describes the features which have resulted in the widespread use of Elliott YR turbines.**

ELLIOTT Company

Q7-1

STEAM TURBINES • MOTORS • GENERATORS • DEAERATING HEATERS • EJECTORS • CONDENSERS • CENTRIFUGAL COMPRESSORS • TURBOCHARGERS • TUBE CLEANERS • STRAINERS



How Bailey stretches

You can wring more energy out of a dollar's worth of fuel when you are getting optimum performance from your steam plant equipment. You get peak performance when Bailey Meters and Controls are on the job. They increase your plant efficiency.

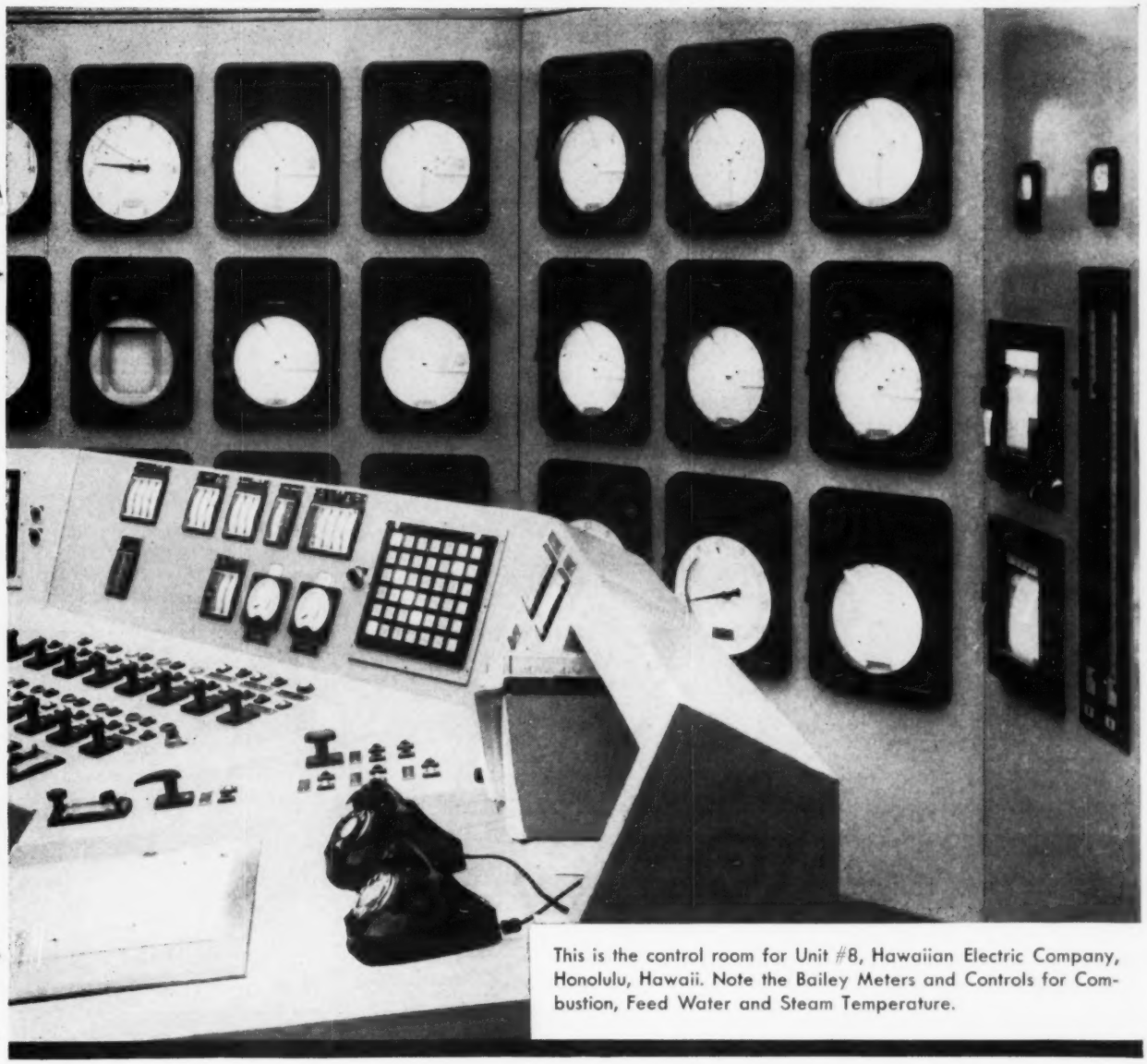
Bailey is the choice of virtually all the most efficient plants on the Federal Power Commission's heat rate report. Here's why:

1. A Complete Line of Equipment

You can be sure a Bailey Engineer will offer the right combination of equipment to fit your needs. Bailey manufactures a complete line of standard, compatible pneumatic and electric metering and control equipment that has proved itself. Thousands of successful installations involving problems in measurement, combustion, and automatic control are your assurance of the best possible system.

2. Experience

Bailey Engineers have been making steam plants work more efficiently for more than forty years. Veteran engineer and young engineer alike, the men



This is the control room for Unit #8, Hawaiian Electric Company, Honolulu, Hawaii. Note the Bailey Meters and Controls for Combustion, Feed Water and Steam Temperature.

your fuel dollar

who represent Bailey, are storehouses of knowledge on measurement and control. They are up-to-the-minute on the latest developments that can be applied to your problem.

3. Sales and Service Convenient to You

There's a Bailey District Office or Resident Engineer close to you. Check your phone book for expert engineering counsel on your steam plant control problems.

A132-2

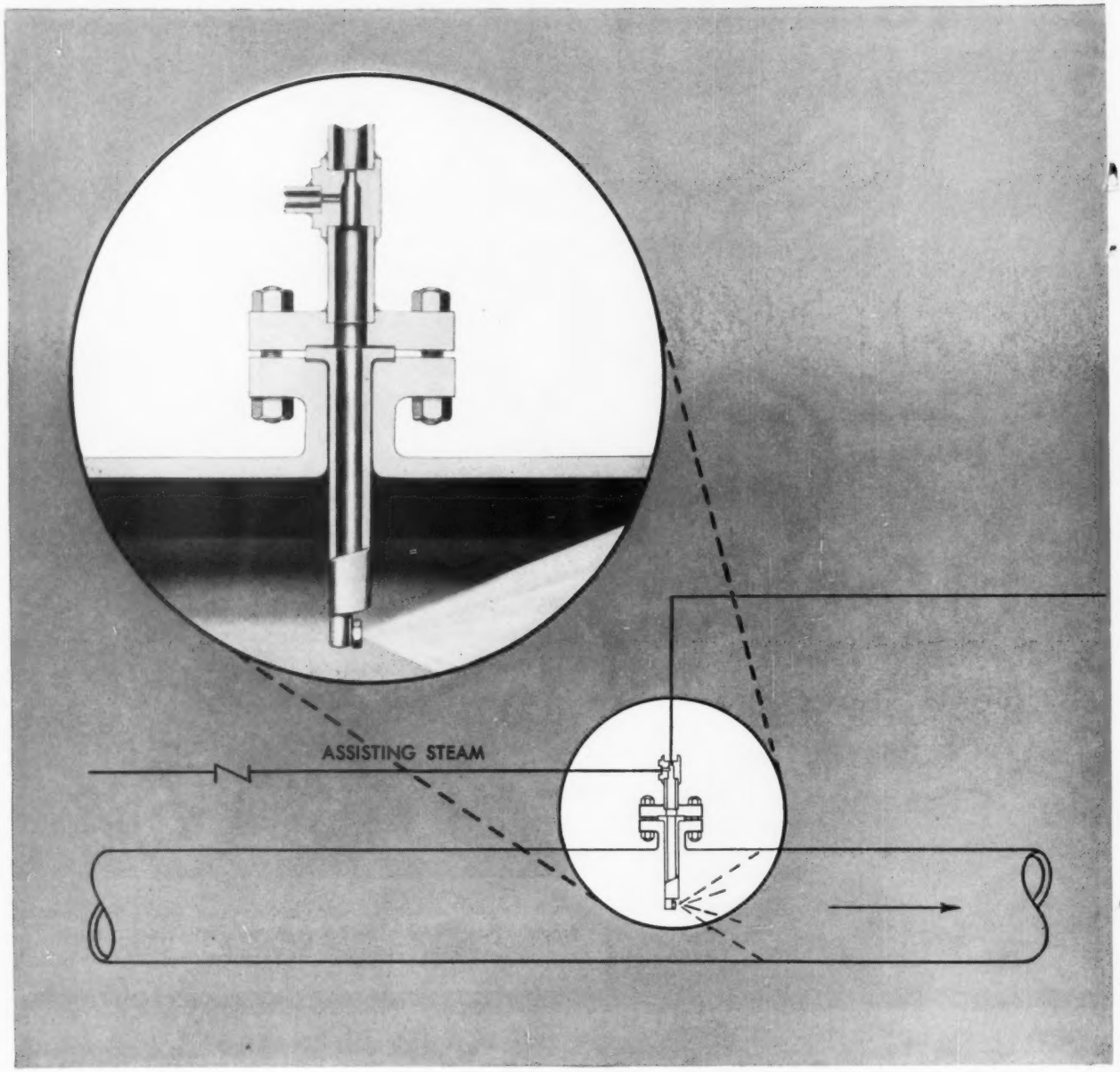
BAILEY METERS

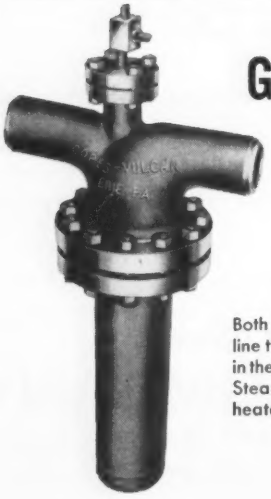
Instruments and controls for power and process

BAILEY METER COMPANY

1036 IVANHOE ROAD • CLEVELAND 10, OHIO

In Canada—Bailey Meter Company Limited, Montreal





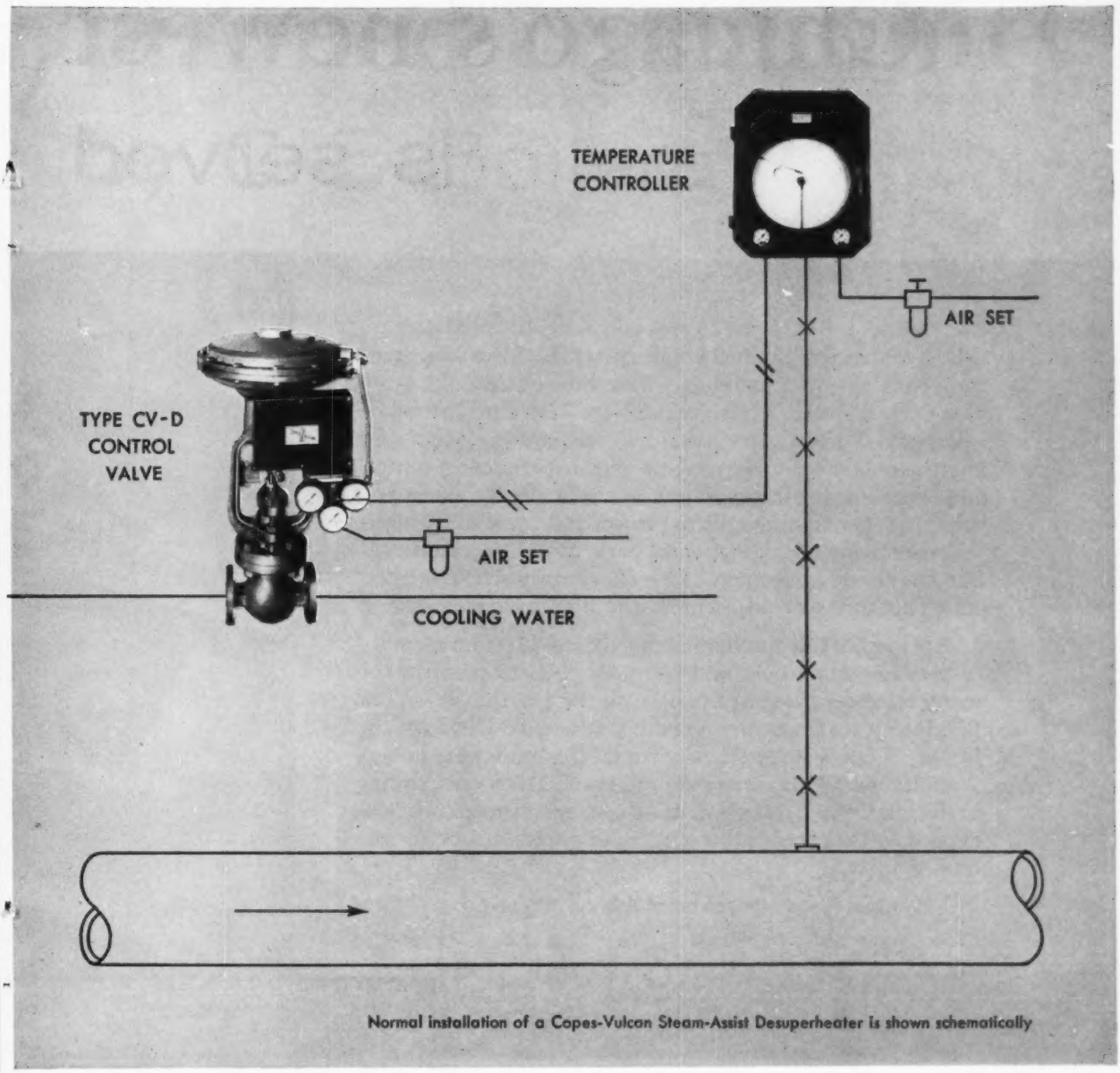
Both carburetor and in-line types are available in the new Copes-Vulcan Steam-Assist Desuperheater.

Get more accurate control with the NEW

Here is a desuperheater based on a new, proven principle that delivers more accurate control of final steam temperature for process work or auxiliaries. It uses steam only on lighter loads. As load increases, the flow of assisting steam is automatically reduced—normally without an atomizing-steam valve. Assisting steam can be off completely at high loads where no more than mechanical atomization is needed. Control is close, even at 10 degrees above saturated temperature.

Cooling water and assisting steam are intimately mixed in the exclusive Swirl Chamber—upstream from the point of injection. No large steam bubbles form to cause annoying hammer or vibration.

Incorporated into the station for close modulating control of cooling water flow is the new Copes-Vulcan Type CV-D



Normal installation of a Copes-Vulcan Steam-Assist Desuperheater is shown schematically

Copes-Vulcan Steam-Assist Desuperheating Station!

Valve. It is designed for the exact operating characteristics suited to your needs.

Enjoy the benefits of Copes-Vulcan desuperheating, custom-engineered for your individual requirements. Be sure of accurate control, minimum maintenance and long service life. Write for Bulletin 1024.

BLAW-KNOX

COPES-VULCAN DIVISION

BLAW-KNOX COMPANY

ERIE 4, PENNSYLVANIA

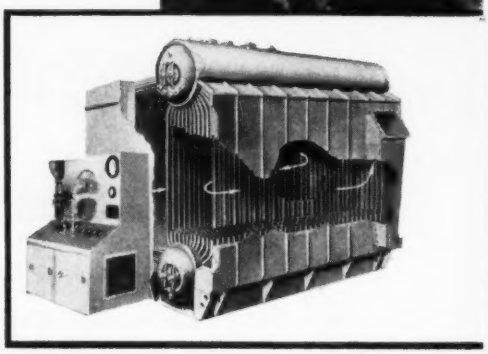
COPES VULCAN

Chicago's newest is served

Located on a 100 acre site overlooking Lake Michigan, Chicago's newest planned community, the Lake Meadows project, offers gracious living within the confines of a large city. Owned and managed by the New York Life Insurance Company, Lake Meadows provides distinctively appointed apartments, spacious grounds, a modern shopping center, ample parking facilities, yet is within minutes of the heart of the city. When completed, this project will house 2000 families and will include an eight acre park. In addition, construction has already begun on a new elementary school located on a two acre plot adjacent to the housing development.

A project of this size requires considerable steam capacity to provide ample heat and hot water and to perform the many other services required. To do the job, the New York Life Insurance Company originally selected 3 C-E Package Boilers, Type VP. Later, as new housing units were added, 2 additional VP Boilers were installed. Their outstanding performance and efficient, trouble-free operation is evidenced by the repeat order placed with Combustion for the final 2 units.

VP Boiler Catalogs are available on request.



Cutaway view of typical VP Boiler. For capacities from 4,000 to 40,000 lb of steam per hr. Pressures to 500 psi. Oil or gas fuel.

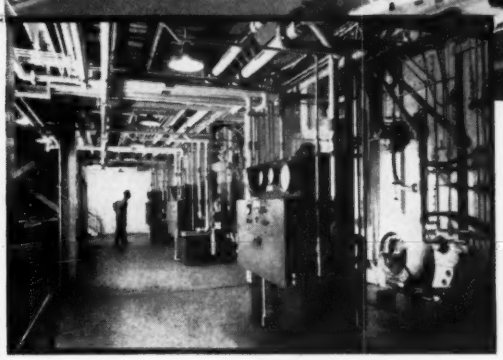
COMBUSTION

Combustion Engineering Building

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT, NUCLEAR REACTORS.

planned community
by C-E Boilers

Architect's rendering of the Lake Meadows project. Skidmore, Owings and Merrill, Architects.



Firing aisle of the Lake Meadows boiler room showing three of the five C-E Package Boilers, Type VP.

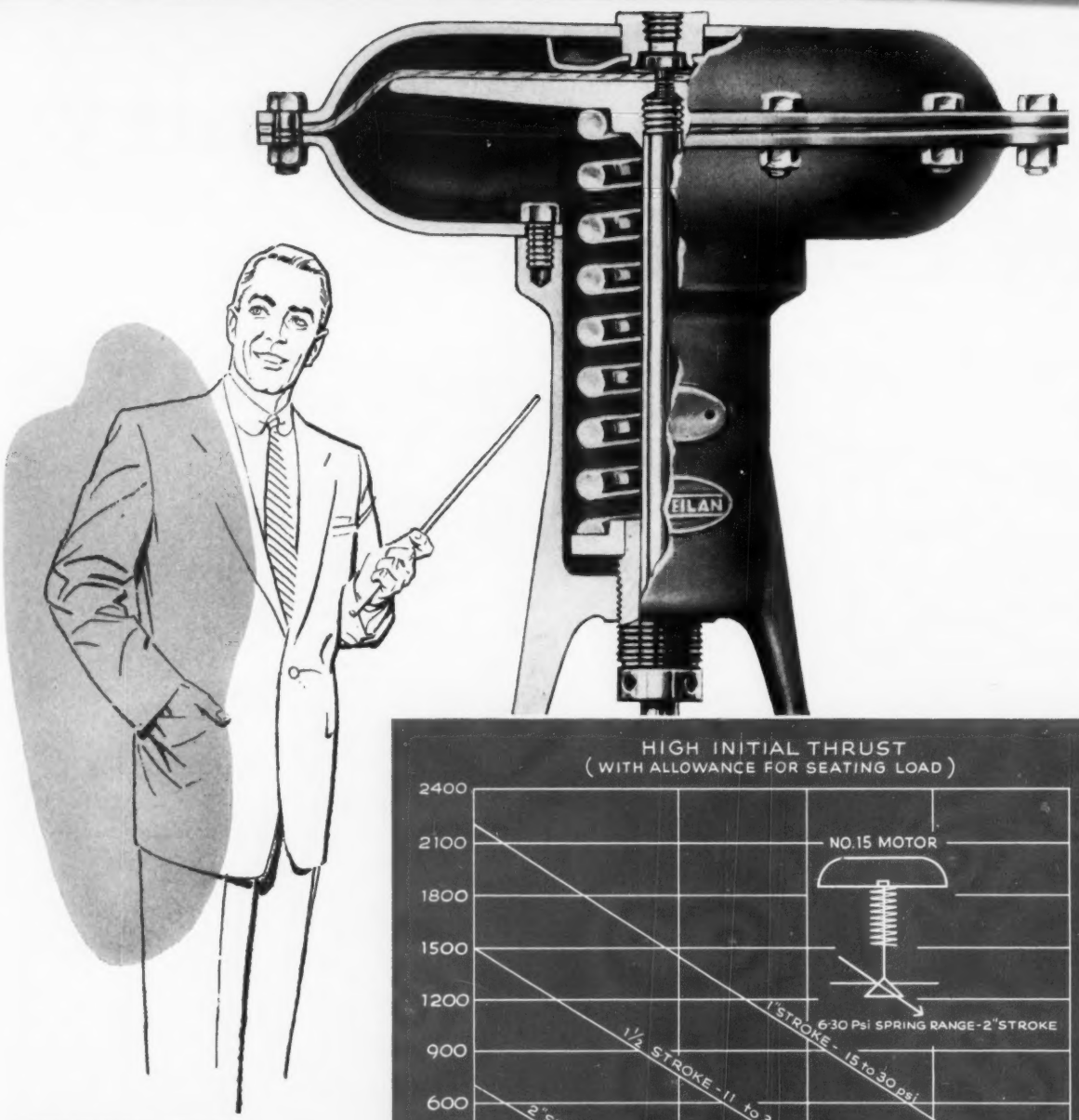
ENGINEERING

200 Madison Avenue, New York 16, N. Y.

C-E

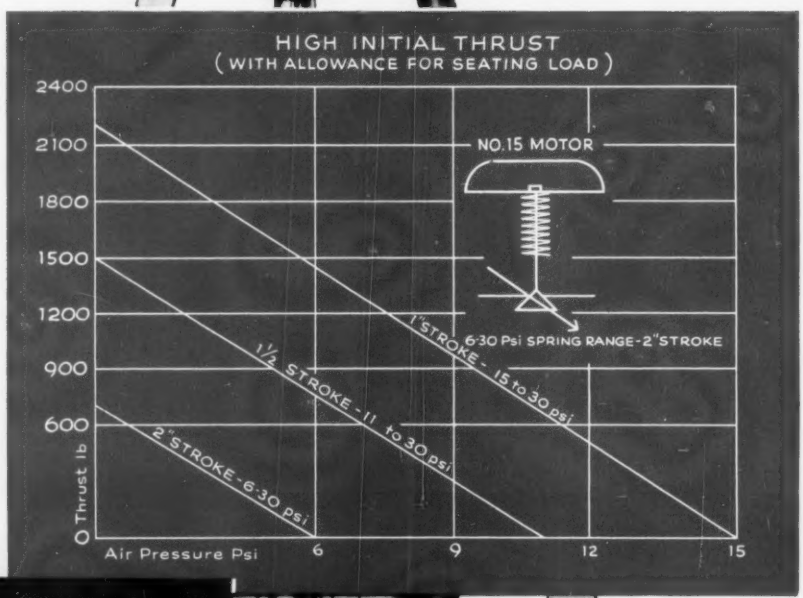
B-986

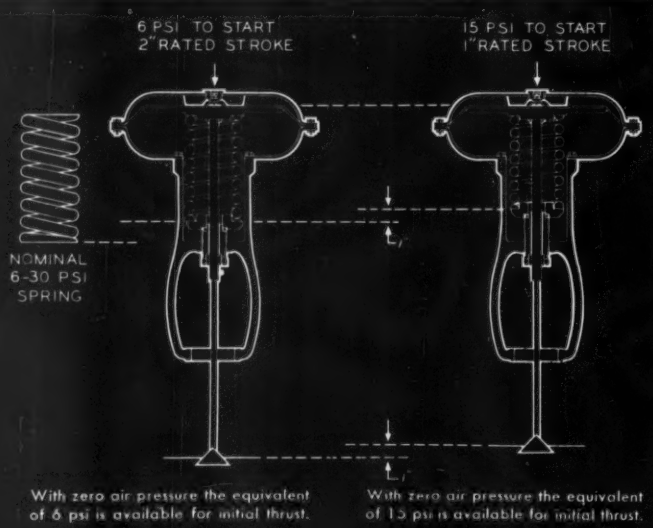
PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE



HIGH INITIAL THRUST:

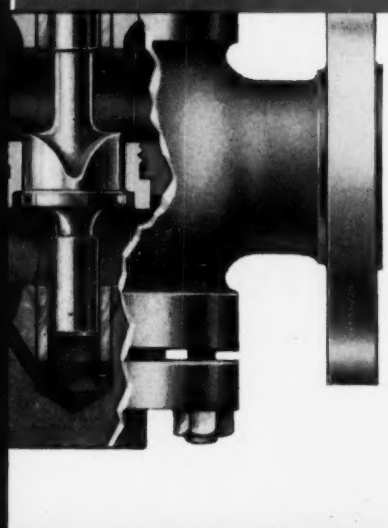
Example — No. 15 Motor with 2″ Rated Stroke and 6-30 psi Spring used on Valves with 2″ and 1″ Strokes.





With zero air pressure the equivalent of 6 psi is available for initial thrust.

With zero air pressure the equivalent of 15 psi is available for initial thrust.



In Single Seated Control Valves

Get AMPLE POWER plus SIMPLICITY, ECONOMY, SAFETY

with Masoneilan Spring-diaphragm Motors

You get the best combination of safety (action on air failure) with maximum potential thrust, plus inherent simplicity and reliability in Masoneilan Spring-diaphragm Motors for single seated control valves.

Many single seated valves are specified to close on air failure. Hence the initial spring compression must provide the force for closing, since the valve would normally be installed with flow tending to open. Thus, to overcome unusual off-balance forces, a high *initial* thrust must be developed.

On air-to-close valves, the motor should develop a high net thrust at the *end* of the stroke. Thus, to overcome unusual off-balance forces a high *final* thrust is essential.

The design of Masoneilan motors enables you to obtain high *initial* thrust or high *final* thrust or, in the case of three-way valves, *both* high initial and final thrust, using, in most cases, standard springs.

Here's how —

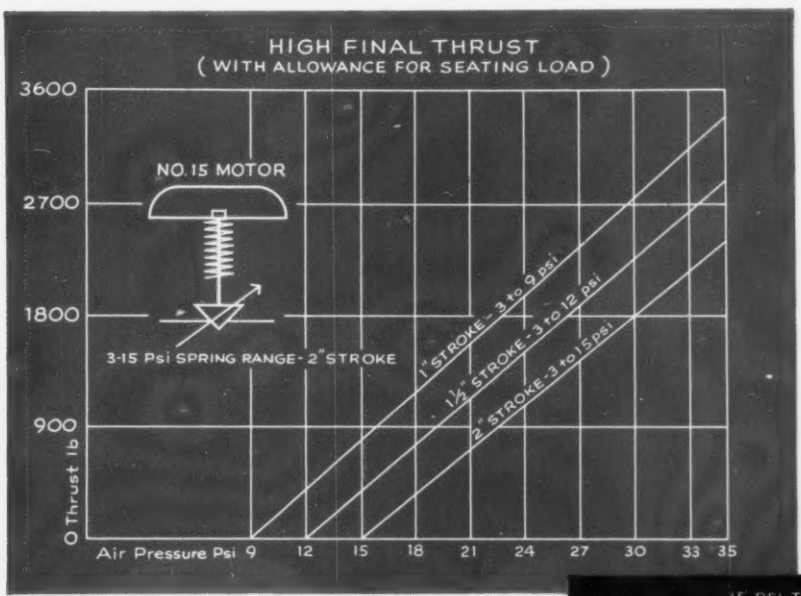
HIGH INITIAL THRUST: Usually an oversize motor is used with a standard spring, but with the difference in stroke used to gain more initial compression and consequent additional spring force.

HIGH FINAL THRUST: The normal size motor often is used by simply increasing the air supply pressure to 30 or 35 psi. If necessary an oversize motor can be used to obtain even greater final net thrust.

HIGH INITIAL AND FINAL THRUST: Using an oversize motor permits adjusting the spring setting to obtain high initial thrust and makes an excess of supply pressure available for high final thrust.

Example — No. 18 Motor with 3½" Rated Stroke and 6-30 psi Spring used on Valve with 2" Stroke.

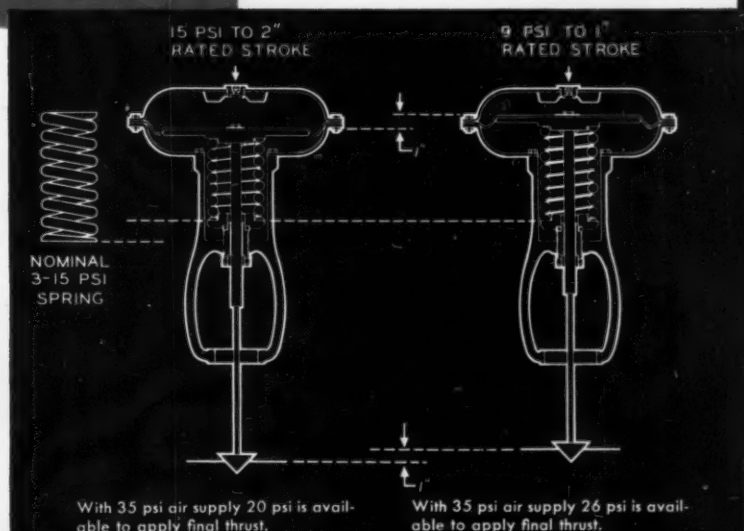
The spring can be set for 8-22 psi nominal range, giving an initial diaphragm load of 8 psi and (with 30 psi supply) 8 psi is also available for final thrust.


HIGH FINAL THRUST
(WITH ALLOWANCE FOR SEATING LOAD)
3600
2700
1800
900
0 Thrust lb
NO.15 MOTOR
3-15 Psi SPRING RANGE-2" STROKE
1" STROKE - 3 to 9 psi
1½" STROKE - 3 to 12 psi
2" STROKE - 3 to 15 psi
Air Pressure Psi 9 12 15 18 21 24 27 30 33 35

Tabulated data are available for facilitating correct control valve selection. Ask our nearest office for Data Sheet 10-11 — or write Mason-Neilan, Division of Worthington Corp., 33 Nahatan St., Norwood, Massachusetts.

HIGH FINAL THRUST:

Example — No. 15 Motor with 2" Rated Stroke and 3-15 psi Spring used on Valves with 2" and 1" Strokes.


15 PSI TO 2"
RATED STROKE
9 PSI TO 1"
RATED STROKE
NOMINAL
3-15 PSI
SPRING
With 35 psi air supply 20 psi is available to apply final thrust.
With 35 psi air supply 26 psi is available to apply final thrust.

MASON-NEILAN

Division of Worthington Corporation

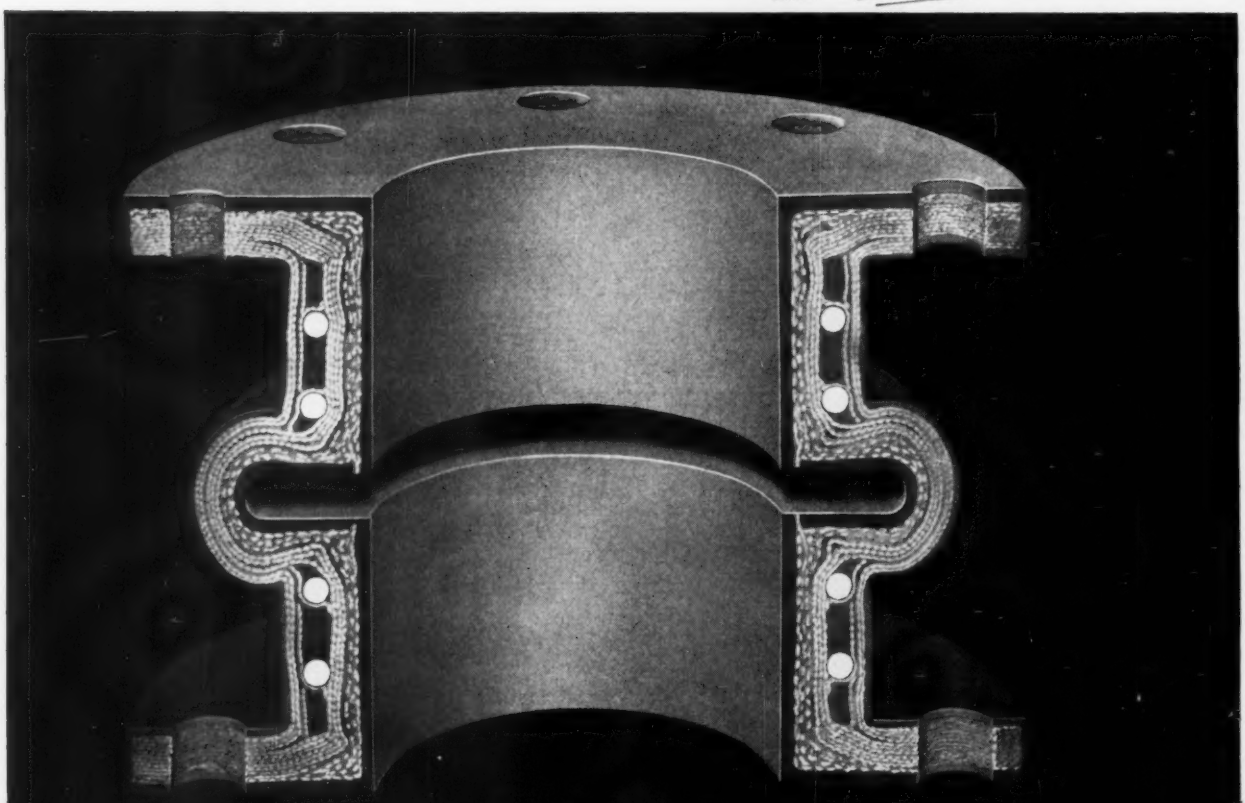
33 Nahatan Street, Norwood, Massachusetts

MASONEILAN

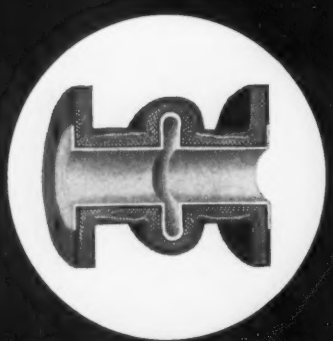
Sales Offices or Distributors in the Following Cities: New York • Syracuse Chicago • St. Louis • Tulsa • Philadelphia • Houston • Pittsburgh Atlanta • Cleveland • Cincinnati • Kansas City • Phoenix • Detroit San Francisco • Louisville • Salt Lake City • El Paso • Albuquerque Charlotte • Los Angeles • Corpus Christi • Denver • Appleton Birmingham • New Orleans • Seattle
Mason-Neilan Regulator Co., Ltd., Montreal and Toronto

ONE OF THE GARLOCK **2,000**

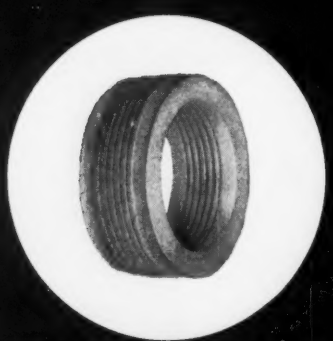
Stop Pipe Line "JITTERS"



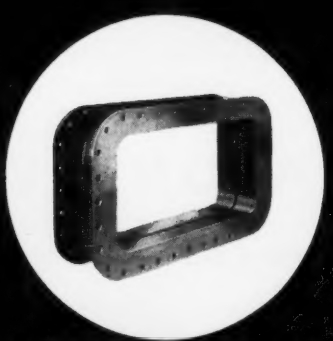
Cutaway of Garlock Rubber Expansion Joint shows steel reinforcing rings which vary in number with size of joint.



Expansion Joint with Teflon liner for moderate pressure service handling liquids or gases harmful to rubbers.

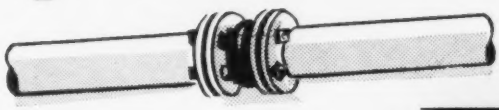


Garlock All-Teflon Expansion Joints for low pressure service handling pure foods, acids, caustics, etc.

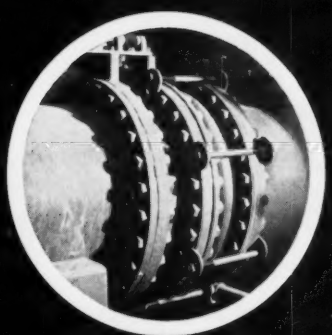


Rectangular Expansion Joints are often used as connection between a turbine and condenser, or for blower ducts.

with Garlock Expansion Joints



Garlock Expansion Joint on 2½" suction and discharge pipes of oil pumps.



Garlock Expansion Joint on 30" pipe line connecting propeller-type circulating water pumps.

This king-size Expansion Joint is used on the world's largest steam generating plant at Kingston, Tenn. It is 60" dia. and is installed between condenser and concrete imbedded water piping.

VIBRATION, NOISE, AND FLANGE BREAKAGE CAN BE ELIMINATED by installing the right Garlock Expansion Joint in your piping. And, the right size and type expansion joint is available for service handling any liquid or gas. For example:

TYPE	USE
• Rubber Expansion Joints (Spool-type, U-type, Tapered, Offset)	Hot or cold water Mild acids or caustics Brine, air, exhaust steam
• Neoprene Expansion Joints	Oil Other Petroleum Derivatives
• Teflon*-lined Rubber Expansion Joints • All-Teflon Bellows-type Expansion Joints	Strong acids and caustics Halogenated Solvents Pure Foods

Rubber Expansion Joints are another important part of the Garlock 2,000 . . . two thousand different styles of packings, gaskets, and seals for every need.

The *only* complete line. That's why you get *unbiased* recommendations from your Garlock representative. Call him or write for Rubber Expansion Joint Folder AD-137.

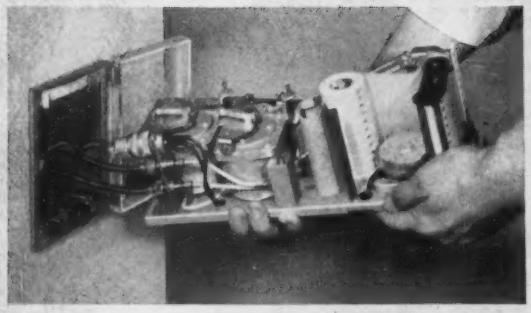
THE GARLOCK PACKING COMPANY, Palmyra, New York

For Prompt Service, *contact one of our 30 sales offices and warehouses throughout the U.S. and Canada.*

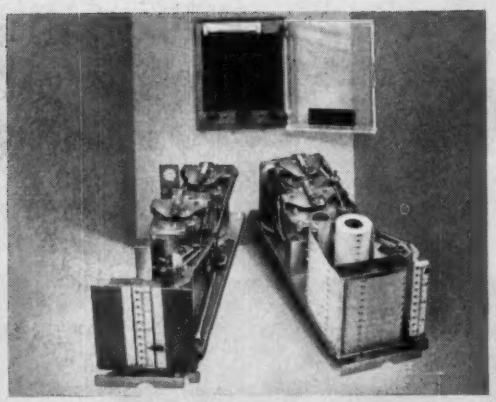
*Du Pont Trademark

GARLOCK

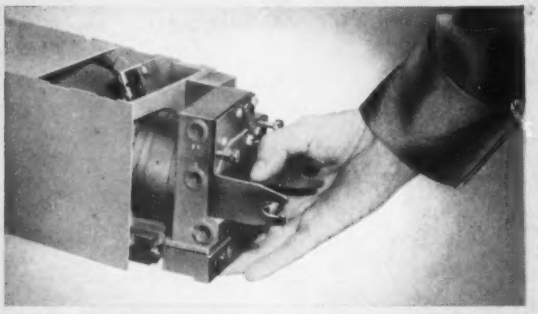
Packings, Gaskets, Oil Seals, Mechanical Seals, Rubber Expansion Joints, Fluorocarbon Products



Easily Serviced—All parts can be inspected during operation, without process interruption. To remove chassis completely, unscrew three finger-tight, self-sealing connections.

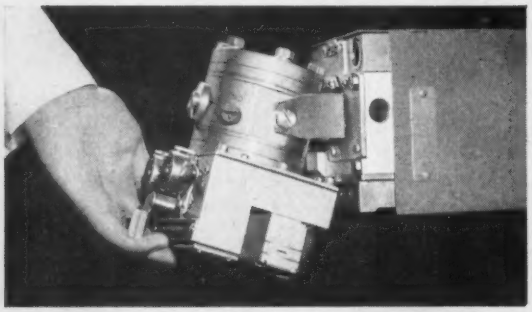


Interchangeable Chassis—Change recorder to indicator or vice versa without interrupting control. Simply pull out chassis, slide another in place.

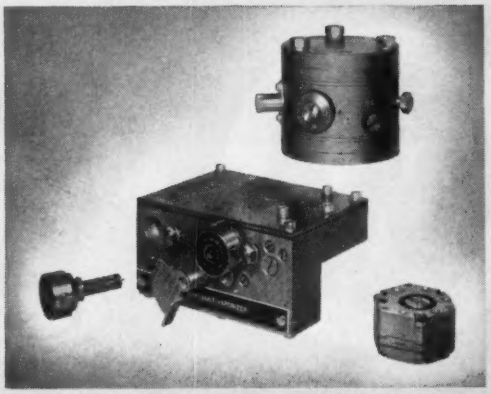


Removable Regulator—Pneumatic assembly, consisting of regulator and switches, can be removed from rear of case without disturbing electrical connections—no need for an electrician to stand by.

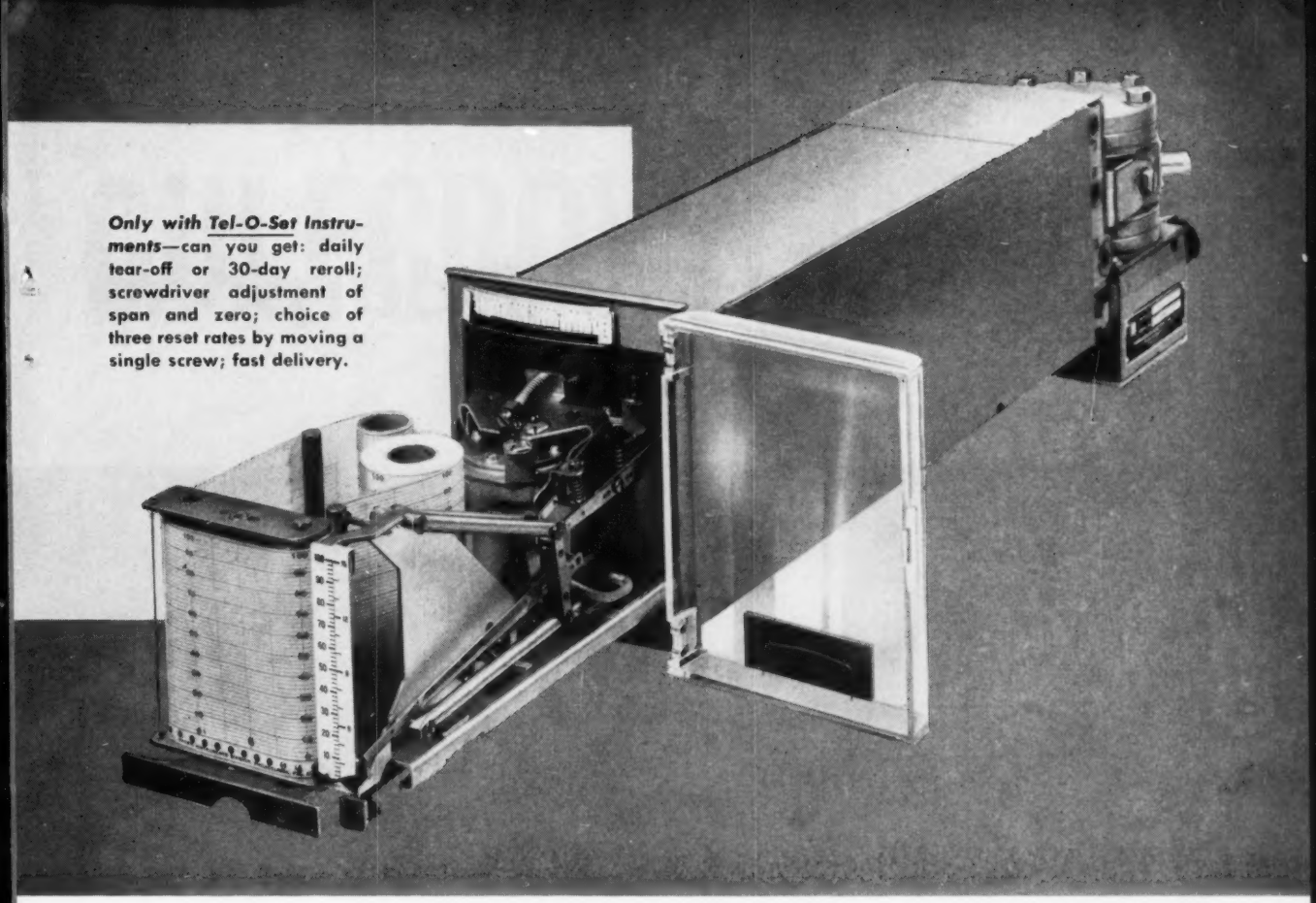
Now you can gain ... *Extra*



Quick-connect Mounting—Controllers have quick-connect switch permitting removal of the unit while process remains on manual control.



Easily Disassembled—Unitized construction of all controller components simplifies maintenance . . . makes reassembly foolproof. No need to dismantle stack to clean pilot assembly.


***Only with Tel-O-Set Instruments*—can you get: daily tear-off or 30-day reroll; screwdriver adjustment of span and zero; choice of three reset rates by moving a single screw; fast delivery.**

Savings with TEL-O-SET*

. . . advanced miniature pneumatic instruments

Tel-O-Set miniature instruments accurately record, indicate, and control process variables. They're applicable to any process variable . . . a savings in itself. And, further savings are accrued from these factors: Only a few models are needed for *all* applications . . . Personnel training time is minimized . . . Spare parts inventory is reduced . . . Process techniques can be changed without buying new instruments. The photographs point up some of the outstanding *Tel-O-Set* features.

For complete information on *Tel-O-Set* instruments, write for Catalog C 1001-1, or call your nearby Honeywell sales engineer. He's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.—in Canada, Toronto 17, Ontario.

*Trade name Minneapolis-Honeywell Regulator Co.

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls

New! Multi-purpose

Gulfcrown stands up to cold. It pumps easily in coldest weather at temperatures of 0°F. and below.

GULFCROWN Grease

does the work of many greases —withstands heat, cold, water

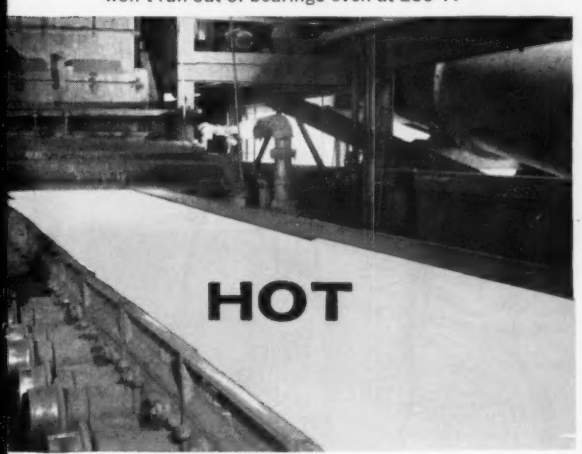
It's a fact—you can use Gulfcrown practically anywhere! On plain or antifriction bearings. In paper mills, textile mills, steel mills, power plants. Outside or inside. You name it, chances are Gulfcrown will lubricate it—but good! Operating conditions can be hot, cold or wet . . . this tough all-purpose grease does its job regardless.

You can see how one multi-purpose grease that does the work of many is a big money-saver. It reduces inventory, cuts lubricating costs and prevents application errors. Check the saving yourself—test Gulfcrown. Ask your Gulf sales engineer or write for free literature.

GULF

GULF OIL CORPORATION
1822 Gulf Building, Pittsburgh 30, Pa.

Gulfcrown resists heat. It won't get thin, won't run out of bearings even at 250°F.



Gulfcrown sheds water—won't wash away. That's why it's a good rust preventive, too, under the dampest conditions such as this wet end of a paper machine.

For Easy Accurate Pipe Cutting with your power drive...

New RIDGID No. 202 Wide-Roll Cutter

- Built-in wide rolls have double the bearing surface on pipe—set and hold at perfect right angle with revolving pipe.
- Assure accurate start for straight cut ... and perfect tracking of cutting wheel.

See how it works—close-up view as cut begins

Every RIDGID Pipe Tool TESTED individually before shipment

New RIDGID No. 202 Wide-Roll Cutter, 1/8" to 2"

Straight Clean Cuts Every Time

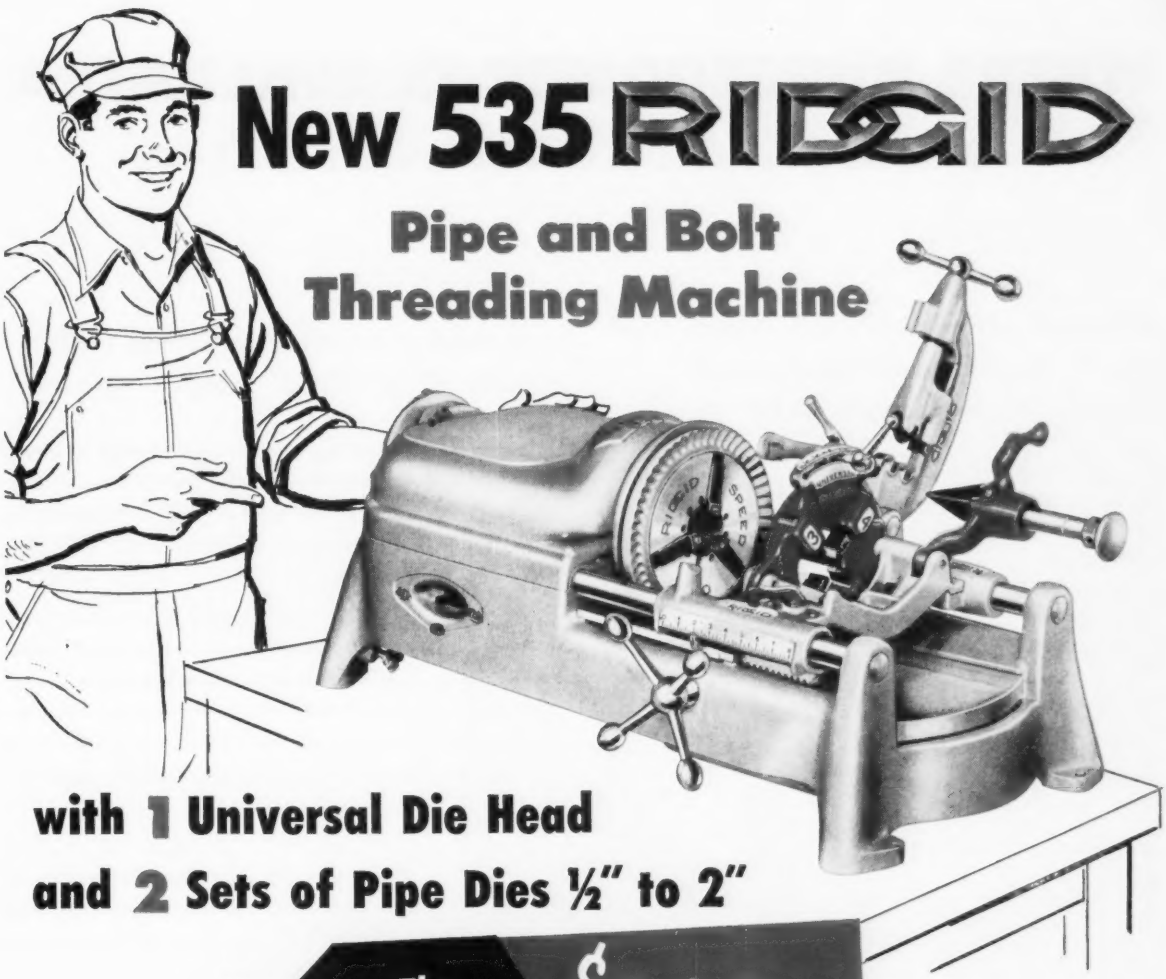
New RIDGID Wide-Roll Cutter is foolproof —you always get straight clean cuts, by hand or power—thin-blade cutter wheel assures least burr ... No bother with special rolls ... Bigger handle for easier cutting ... New long shank protects threads on cutter screw from wear on power drive support bar ... Rugged warp-proof body ... For extra fast easy accurate pipe cutting, see, try, buy it at your Supply House.

RIDGID
Work-Saver Pipe Tools

The Ridge Tool Company, Elyria, Ohio, U.S.A.

New 535 RIDGID

Pipe and Bolt Threading Machine



with 1 Universal Die Head

and 2 Sets of Pipe Dies ½" to 2"

The Complete Package **$460.00**

(slightly higher in Canada)

Your best bargain in fast easy threading . . . by power

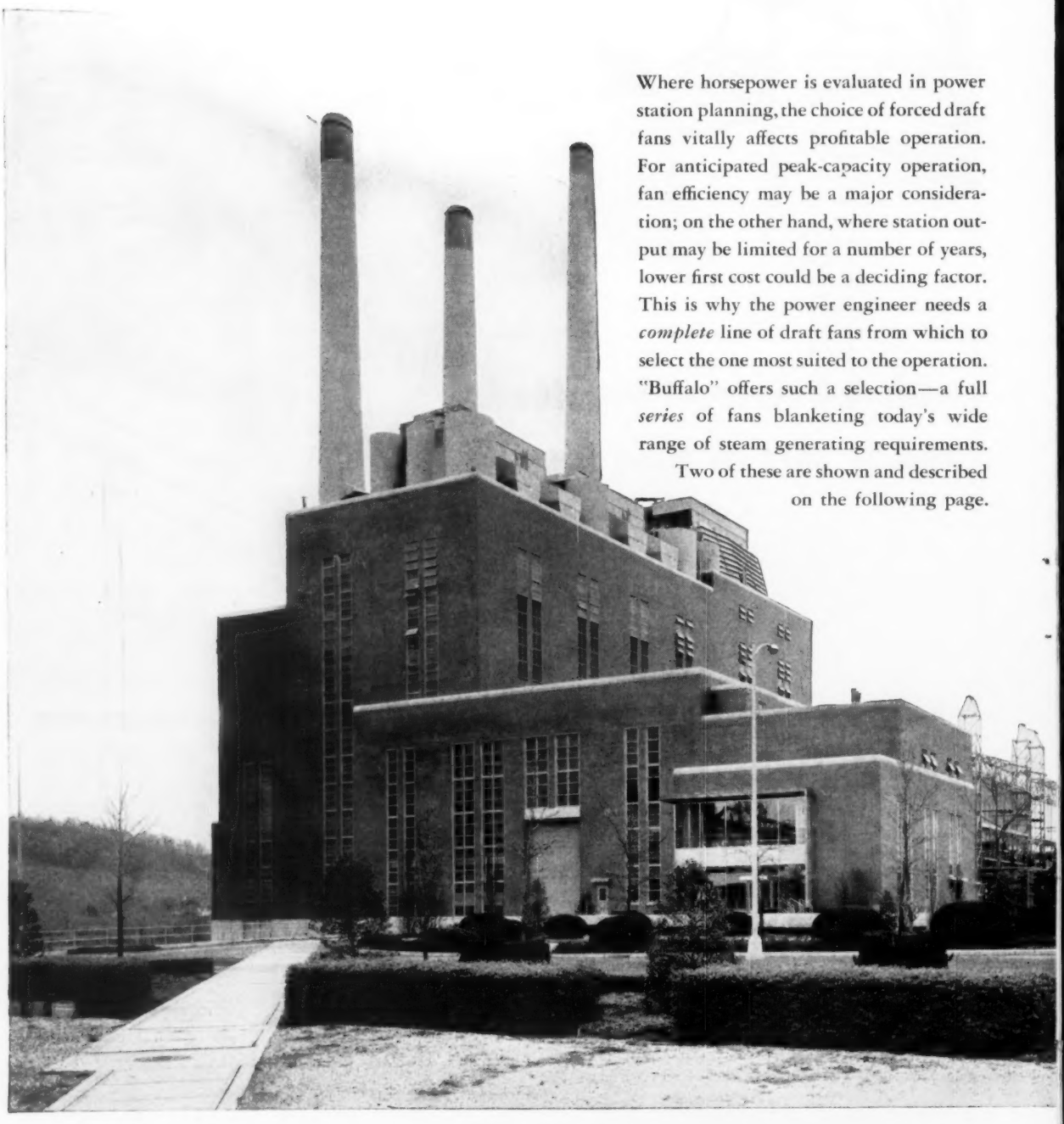
Complete machine, including Speed Chuck guaranteed to grip tight any pipe or conduit, forward, reverse . . . 1 universal quick-opening die head that adjusts to size right in machine, with 2 sets of dies, one for ½" and ¾", one for 1", 1¼", 1½", and 2". A full range of pipe and bolt dies to fit the same universal head are available. Roll type cut-off with self-centering full-floating cutter wheel . . . Five-Flute cone reamer, ⅛" to 2" . . . *Above 3 tools operate independently, swing up out of way when not in use, so pipe can be chucked from front . . .* Powerful 115/120 volt universal motor . . . All 500 and 500A die heads and accessories fit this 535 machine . . . See all the other RIDGID efficiency features of this remarkable 535 at your Supply House!

You can't afford to thread, cut and ream pipe by hand!

Work-Saver RIDGID Pipe Tools

The Ridge Tool Company, Elyria, Ohio, U. S. A.

WHERE HORSEPOWER IS EVALUATED



Where horsepower is evaluated in power station planning, the choice of forced draft fans vitally affects profitable operation. For anticipated peak-capacity operation, fan efficiency may be a major consideration; on the other hand, where station output may be limited for a number of years, lower first cost could be a deciding factor. This is why the power engineer needs a *complete* line of draft fans from which to select the one most suited to the operation. "Buffalo" offers such a selection—a full *series* of fans blanketing today's wide range of steam generating requirements.

Two of these are shown and described on the following page.

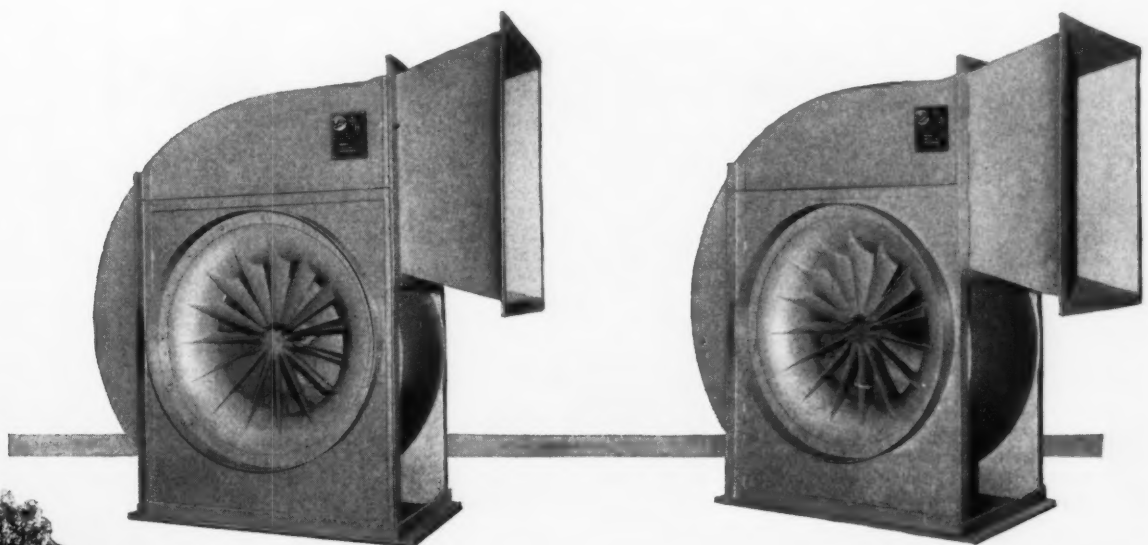
— THESE "BUFFALO" DRAFT FANS
OFFER IMPORTANT ADVANTAGES

High Efficiency Over a Broad Range—Type "BLH" F. D. Fan

This backward-curve fan is providing performance characteristics highly desirable for many stations. Designed for Classes II-IV operation (system pressures above 3¾"), its mechanical efficiency is above 80% over a very broad range, providing flexibility over wide load variations. Its complete streamlining includes the proven inlet bell, directional inlet vanes, backward curve blades, wheel-suited housing and divergent outlet — features offered exclusively by "Buffalo". Like the "Buffalo" Airfoil Fans, the "BLH" is used efficiently with "Buffalo" Variable Inlet Vane volume control. Write for Bulletin F-200.

Maximum Efficiency for Specific Operating Conditions— Type "BA" Airfoil F. D. Fan

"Buffalo" Airfoil Fans offer mechanical efficiency up to 92%, and are available with a choice of three wheels to match widely varying pressure requirements. These fans have extra-wide blades for a deep "bite" — extremely good inlet conditions, thanks to the smooth inlet bell and matching curved wheel flange — plus excellent static conversion thru the unique new "Buffalo" divergent outlet. Available with "Buffalo" Variable Inlet vanes — which do not reduce performance — for volume control. Write for Bulletin FD-106 for full details.



In every "Buffalo" product is the "Q" Factor, or built-in Quality which provides trouble-free satisfaction and long life.

BUFFALO FORGE COMPANY
BUFFALO, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

"Buffalo"

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING
FORCED DRAFT COOLING HEATING PRESSURE BLOWING

"UNIFORM TUBE DUCTILITY

"We've had good experience with Republic

SPECIFICATIONS

Capacity . . . 110,000 pounds of steam per hour
Design Pressure . . . 476 psi.
Operating Pressure (at super-heater) . . . 420 psi.
Steam Temperature . . . 750° F.

REPUBLIC

REPUBLIC STEEL

World's Widest Range of Standard Steels

makes any boiler job easier"

ELECTRUNITE *Boiler Tubes"*

—says "Red" Thompson,
Combustion Engineering Construction Foreman

"Red" Thompson is typical of expert boiler-construction foremen all over the country. To them, uniform ductility in boiler tubes means smooth, accurate bends, easy roller-expansion and bead-over. Tight, weeper-free joints. It all adds up to easier, more economical installations.

That's why they like to work with Republic ELECTRUNITE® Boiler Tubes. Every tube is uniformly ductile. But more important, Republic Tubes assure *dependability* where it counts the most: in long-term operation.

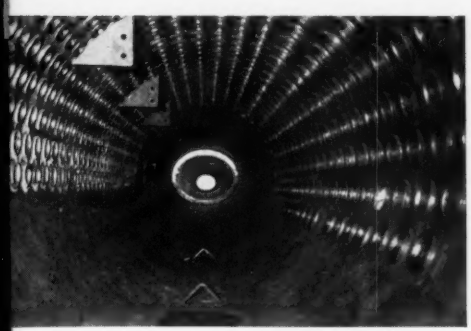
This recognition of the efficiency and dependability of ELECTRUNITE Tubes is reflected by the number of boilers everywhere that are protected with Republic Tubes. One of the more recent is this new steam generator (left) built for the city of Garland, Texas. Designed and erected by Combustion Engineering, Inc., New York, it has a capacity of 110,000 pounds of steam per hour, can operate at 476 psi. and 750° F. And there's a lot of ELECTRUNITE on the job to help provide top performance.

Successful tube performance is dependent on precise manufacturing techniques. Republic's ELECTRUNITE welding process produces an accurate, uniform, wall thickness assuring uniform heat transfer all around and throughout the length of each tube. Dependability cannot be threatened by longitudinal thin spots. Each length of tube is hydrostatically or electronically tested to conform to the applicable ASTM specification and the requirements of the ASME Boiler and Pressure Vessel Code, as well as local, state and boiler-insurance requirements. In addition, ELECTRUNITE is approved on an equal basis with tubes made by any other process up to 850° F. It is available for pressures over 2000 psi. in various sizes and wall thicknesses.

Before you specify tubes for new or existing installation, get all the facts on ELECTRUNITE Boiler, Condenser and Heat Exchanger Tubing from your local Republic Representative. Or send coupon for literature.

SPECIFY FARROWTEST®

Here's the most conclusive, non-destructive electronic tubing test in use today. Developed by Republic, FARROWTEST provides detector coils that can electronically spot defects in tube walls which would be hidden from routine test procedures. You can specify FARROWTEST on ELECTRUNITE Boiler Tubes instead of your present method, at no extra cost.



REPUBLIC ELECTRUNITE BOILER TUBES ALWAYS ROLL IN EASILY— thanks to the uniform ductility and concentricity throughout every inch. They slide through drum holes freely, roller-expand and bead-over to make tight, non-leaking joints.

FREE WALL CHART, entitled "Care and Maintenance of Boiler Tubing", is a handy guide for protecting your present boiler installations. Send for it today by checking and mailing coupon.

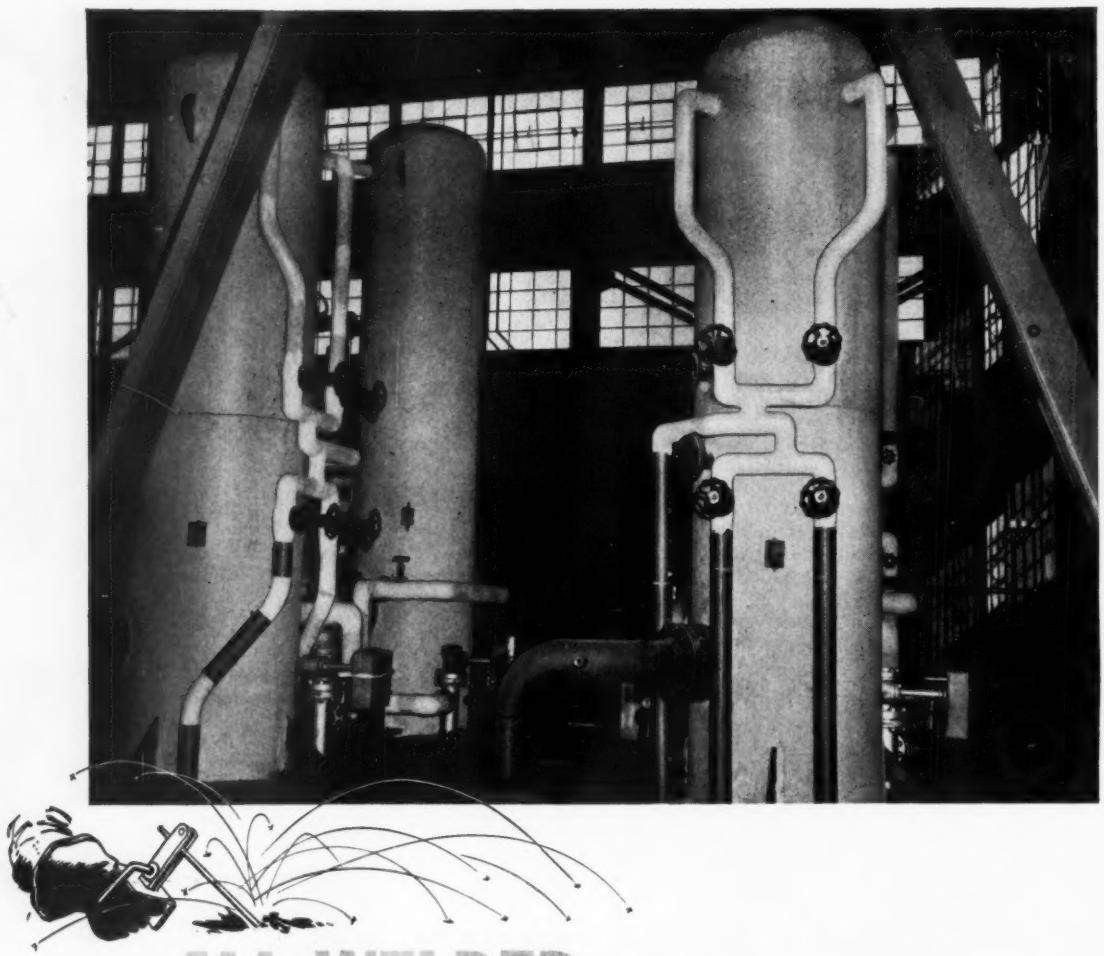
STEEL

and Steel Products

REPUBLIC STEEL CORPORATION
Dept. C-3510
3144 East 45th Street, Cleveland 27, Ohio

Please send
- ☐ Illustrated booklet giving facts on ELECTRUNITE Boiler Tubes
- ☐ Eight-page brochure on ELECTRUNITE Heat Exchanger Tubing ☐ Carbon Steel ☐ Stainless Steel
- ☐ Handy wall chart on care and maintenance of boiler tubes
- ☐ FARROWTEST brochure

Name_____ Title_____
Company_____
Address_____
City_____ Zone____ State_____



FIRST ALL-WELDED FEEDWATER HEATERS

installed at Schiller Station, Public Service of New Hampshire

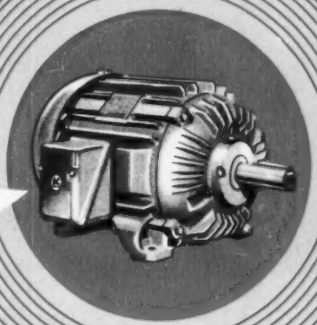
THE INSTALLATION shown above consists of two 175 psi low-pressure and two *all-welded*, 2000 psi high-pressure feedwater heaters installed at the Schiller Station of Public Service Company, Portsmouth, New Hampshire. The high-pressure heaters are the first units of the new FW all-welded "bottle-tight" design ever put into service.

The chief advantage of the all-welded construction is the elimination of all maintenance problems presented by bolted and gasketed joints. Quicker start-ups are possible because there is no danger of leakage under severe thermal shocks. The shell-to-adapter joints, tube-to-tubesheet joints and the closure are all welded. Each of these welds has been successfully field tested for at least six years on other equipment.

The new Foster Wheeler all-welded feedwater heater can provide *you* with positive protection against gasket leaks and gasket maintenance. For further information, write to *Foster Wheeler Corporation, 165 Broadway, New York 6, N.Y.*

FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.



The real cost of MOTORS

The cost of a motor extends over its entire lifetime. It does not end with purchase price. Cost *goes up* with every shutdown, every motor maintenance stoppage. Cost *stays down* when you buy quality. And quality means Allis-Chalmers.

All of these extras that don't show on the Allis-Chalmers nameplate — more copper, more iron, more cooling provisions—exemplify the quality-craftsmanship that goes in before the price tag goes on.

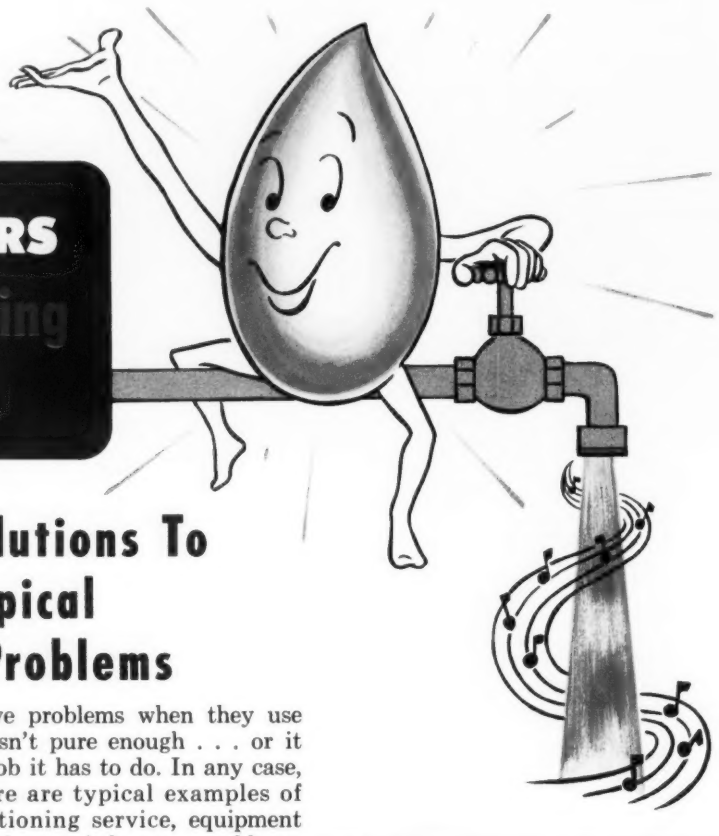
For the "long run," either as a new machinery component or as replacement, specify Allis-Chalmers. Find out more about *real* quality in motors from your A-C district office or distributor, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

A-C ALLIS CHALMERS

A-5287

ALLIS-CHALMERS
Water Conditioning
ON THE JOB



Happy Solutions To 4 Typical Water Problems

● Everybody seems to have problems when they use water. It's too pure, or it isn't pure enough . . . or it needs conditioning for the job it has to do. In any case, a specialist is needed. Here are typical examples of Allis-Chalmers water conditioning service, equipment and chemicals at work solving varied water problems.

Drought Adds to Woes of River Water Users

CALIFORNIA—Things looked bad at a paper company when the first water samples came in. In fact, one water conditioning company went so far as to say that the alkalinity of the water could never be reduced to a satisfactory level.

But on the assurance of Allis-Chalmers experts, a de-alkalizer was ordered for boiler make-up water.

In the meantime there was a drought. The drought made the river water conditions even worse than they had been, so that by the time the equipment was installed there was real trouble with alkali.

Allis-Chalmers engineers had an unusually tough problem on their hands. Instruction, experiment, on-the-spot service, and a program of constant control have resulted in production of satisfactory boiler make-up.

Saved $60,000 in New Equipment

LOUISIANA—A low pressure industrial steam plant was being supplemented by a 1250-lb boiler. The question arose—can any of the old water conditioning system be used? Preliminary investigation indicated the need for demineralization equipment to get the desired water quality for make-up in the new equipment.

A survey of the records showed that it would be possible to use condensate from the low pressure system as make-up for the high pressure system. This solution of the problem required less modification of equipment than was originally anticipated . . . saved an estimated $60,000.

Stained Glass Has Its Place, But Not in Nursery

ILLINOIS—A nursery was spraying water over the outside of its glass hothouses to control the temperature inside. The method was effective, but the iron stains from the water were troublesome. Allis-Chalmers water conditioning experts recommended A-C's 130 Series complexing agents. This did the job by preventing the iron from depositing on the glass.

Battle with Algae Ends in Knockout

KENTUCKY—A petroleum company is finding out what a lethal weapon Allis-Chalmers new 120 Series algaecide really is. Previously they used sodium hypochlorite, but their cooling tower algae problems were not solved. Now they have complete control . . . using concentrations of only one-half of what is normally recommended. They also say it's easier to handle and apply, and better in every way, than anything they've ever used before.

Get Help on Your Water Problems

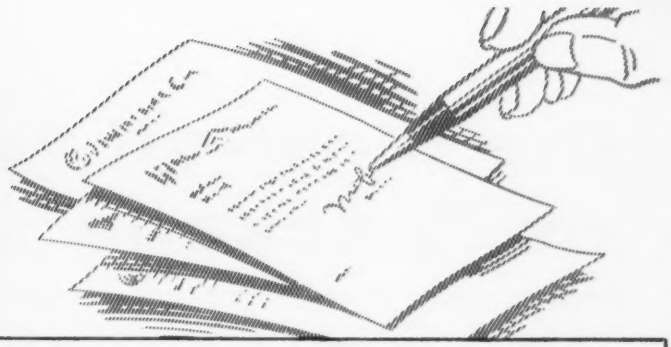
Whether you need chemicals, equipment or service, Allis-Chalmers provides an unbiased recommendation based on over 25 years' experience. No problem is too big or too small. Specialists are located in many cities. Call your nearby A-C office or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

A-C ALLIS CHALMERS

A-5304

WHAT UNBIASED RECOMMENDATIONS MEAN TO YOU



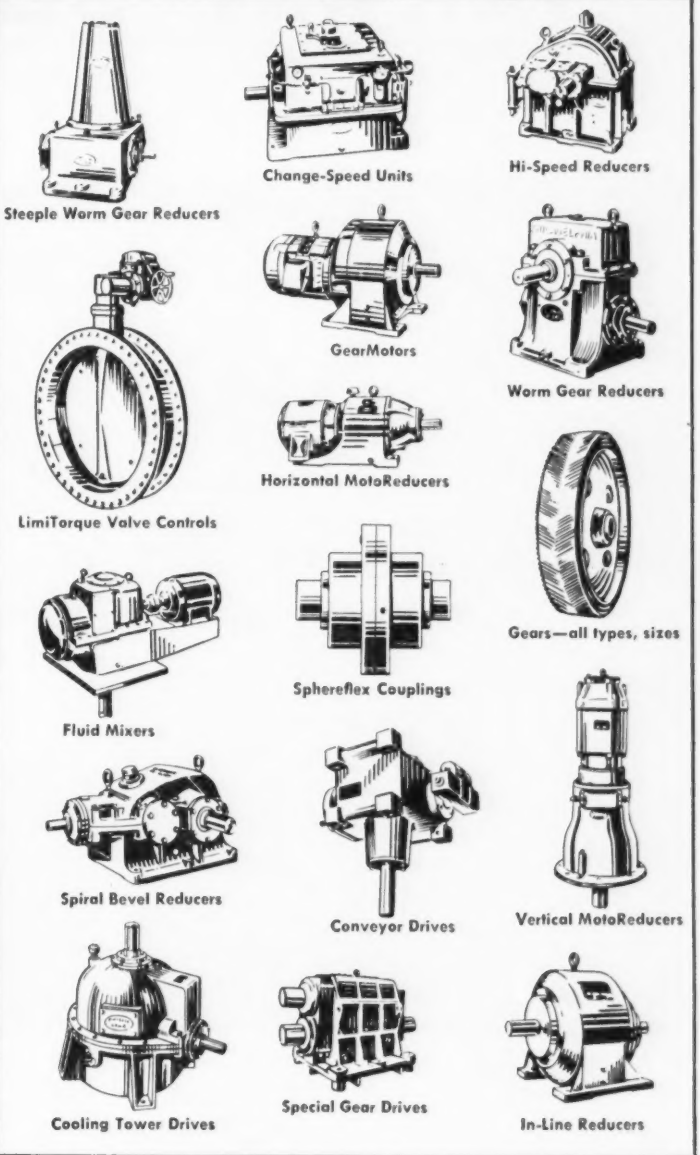
Because we make *every type and size* of Gear Driven Power Transmission Unit, we can recommend a *specific unit* for your particular requirements, which is exactly the *right type and size to give you the most efficient service and longest possible life* . . . Our recommendations are completely "unbiased", because we do not have to limit them to just one or two types. We have also found that many firms like to order their Units from *one manufacturer*—and to make that one manufacturer responsible for the selection and operation of all their Reducers.

Whatever your drive problem may be, whether speed reducing, speed increasing, motorized operation of valves, fluid mixing, or the coupling together of driving and driven units —it will pay you to call upon "Phillie Gear" Engineers.

Upon request on your Business Letterhead, we shall be glad to send you a copy of our "All Products Bulletin", or a complete Catalog on any type of Unit illustrated herewith.

AGMA

Member of the American Gear Manufacturers Assn.



phillie gear®

PHILADELPHIA GEAR WORKS, INC.

ERIE AVE. & G STREET, PHILADELPHIA 34, PENNA.

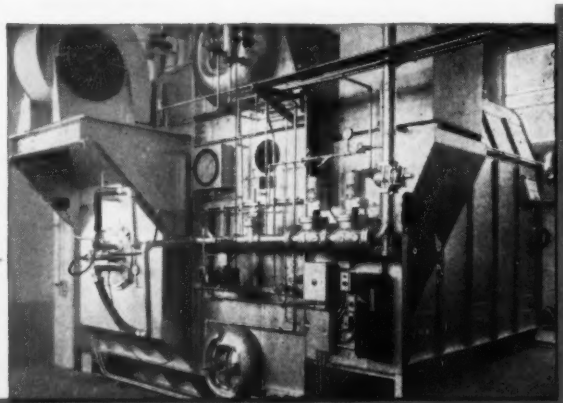
Offices in all Principal Cities

INDUSTRIAL GEARS & SPEED REDUCERS • LIMITORQUE VALVE CONTROLS • FLUID MIXERS • FLEXIBLE COUPLINGS

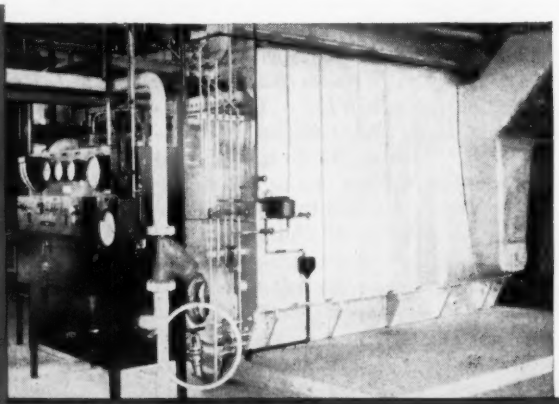
Virginia Gear & Machine Corp. • Lynchburg, Va.

the blow-off valve trend on "package" boilers is

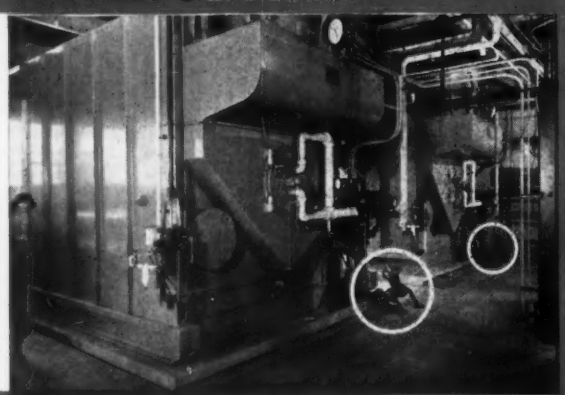
YARWAY SEATLESS



E. KEELER



COMBUSTION ENGINEERING



TITUSVILLE

KEWANEE-SPRINGFIELD

YARWAY® **BLOW-OFF**

■ More and more leading manufacturers of package-type boilers are featuring Yarway Blow-Off Valves on their units. Many are standardizing on Yarways.

The reason—good blow-off valves help good package boilers *perform better*.

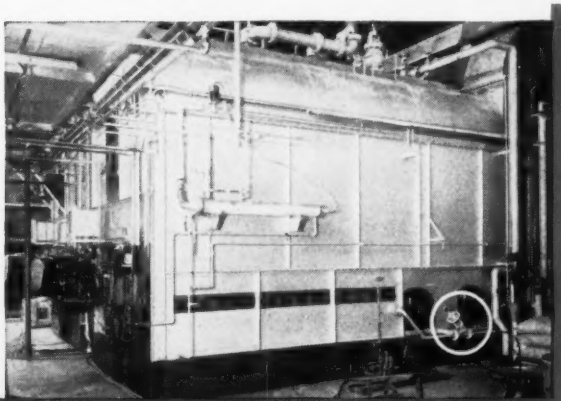
Yarway—known for nearly 50 years for *quality* blow-off valves—offers advanced design, dependable service, and reasonable cost . . . three features attractive to all boiler users.

The Yarway Seatless Blow-Off Valve, with balanced hollow sliding plunger and no seat to score, wear, clog or leak, is the most widely used valve for low and medium pressures.

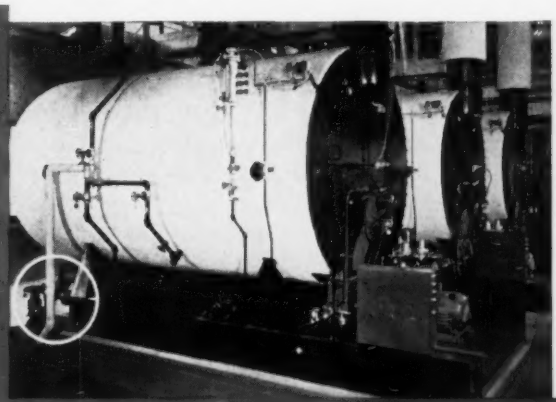
Specify Yarway Seatless Blow-Off Valves on your package boilers. All boiler makers will supply them.

For full description of Yarway Seatless Blow-Off Valves write for Yarway Bulletin B-426.

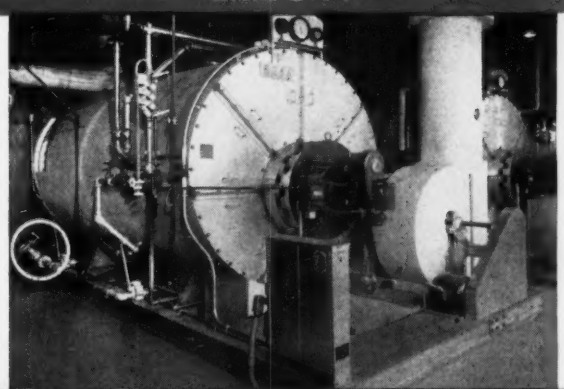
YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES



● ERIE CITY



● CLEAVER-BROOKS



● PREFERRED UTILITIES

● **Yarway Seatless Tandem Blow-Off Valve** (angle-straightway combination) with angle valve sectioned to show balanced sliding plunger design.

● **Yarway Seatless Tandem Blow-Off Valve,** angle-angle combination, straightway-angle or straightway-straightway tandems also available.

VALVES

Argonne National Laboratory Experimental Boiling

Electricity from NUCLEAR POWER TODAY!

NOW in operation at Lemont, Illinois, this is the first commercial-type power plant in the United States to generate usable quantities of electric power from nuclear fuels.

The unique feature of this boiling water reactor is that live steam is actually generated in the uranium core by nuclear heat and piped directly to the turbine without need for intermediate heat exchangers as required by other types of reactors. In effect, it operates very much like the coal-fired boiler in a conventional power plant.

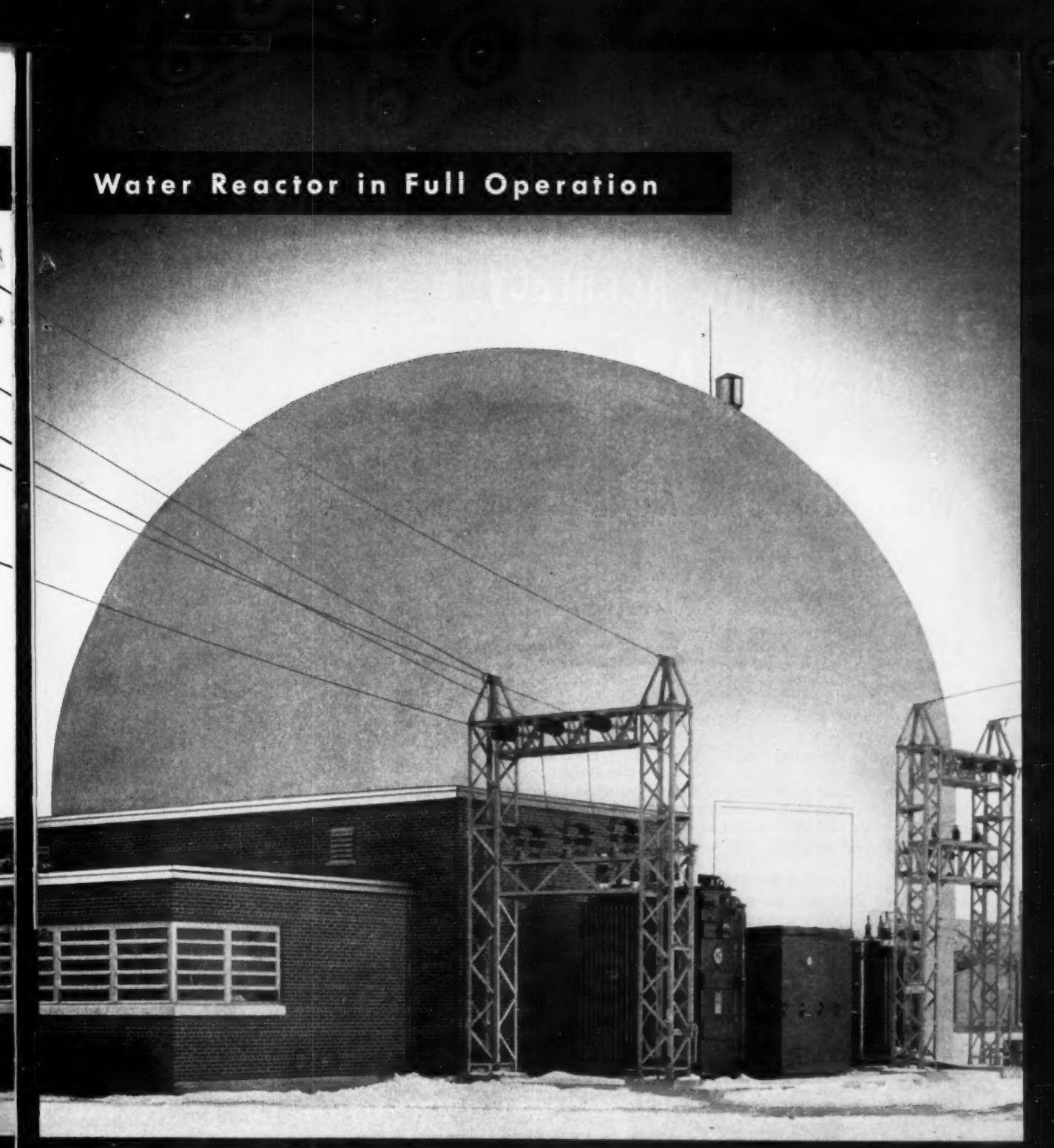
This unit is rated at 20,000 kilowatts of heat and 5,000 kilowatts of electricity. It was designed for experimental use, to evaluate potentials of the boiling water reactor for large-scale commercial applications. Power generated is used by the Laboratory to meet a portion of its own electric power requirements.

Allis-Chalmers is proud of its association with this significant project. It's another example of "Engineering in Action" to provide power for better living from any source, whether it be water, steam, oil, or the atom itself.

Direction of over-all design and construction phases as well as design and manufacture of reactor core and control rod devices was by Argonne National Laboratory.

Power Equipment Supplied by Allis-Chalmers

- Steam turbine generator and exciter
- Surface condenser and air ejectors
- Complete control center for remote operation of reactor and power equipment
- Reactor water recovery and air drying system
- Reactor steam bypass control system
- Hermetically sealed pumps for reactor purification system
- Reactor feedwater pumps
- Circulating water pumps
- Auxiliary cooling water pumps
- Motor control centers
- Main and reserve power transformers
- Indoor and outdoor switchgear
- Automatic voltage regulator
- Circulating water treatment system
- Ac-dc distribution center
- Diesel-generator set



ALLIS-CHALMERS

MILWAUKEE 1, WISCONSIN

A-5344

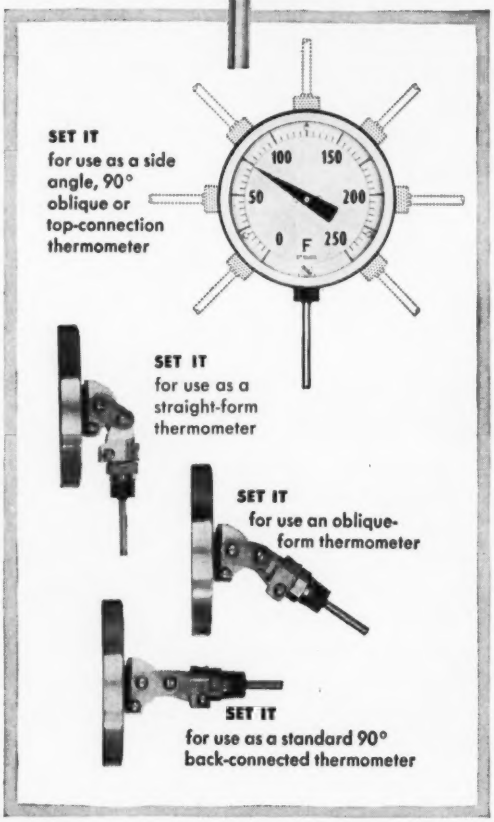
"Every Angle" Design Maxivision® Accuracy Bi-Metal Actuation

Now...all 3 in one 'American' Thermometer

Only this new American Thermometer* gives you the three features most demanded in a dial thermometer. The "Every Angle" design allows you to install this thermometer *anywhere* . . . then angle it in the direction that provides easiest reading. The anti-parallax Maxivision dial guarantees the surest, sharpest, easiest reading. Graduations are carried on a raised ring, set close to the cover glass, with an index-type, functional pointer set at the same level. The result – no perspective effect – parallax error practically eliminated. Finally, bi-metal actuation insures high sensitivity, economy, and surety of operation.

Install the new American "Every Angle" Bi-Metal Dial Thermometer anywhere – inside or out. Its climate-proof case defies any weather condition. The full use of these thermometers in any process plant makes possible temperature readings with the same ease and facility of those of a pressure gauge. Write today for complete information. Ask for Bulletin 148.

*Pat. App. For



SPECIFICATIONS

5-Inch Type 5-6060 American "Every Angle" Bi-Metal Dial Thermometer

Temperature Ranges: From minus 80° to plus 1000° F. Accuracy within 1% of range. *Dial Size:* 5". Scale approximately 10½" long. *Bi-Metal Coil:* Low mass, with single helix close to inside wall of stem assures high sensitivity. Silicone fluid dampens vibration, accelerates transfer, speeds response. *Case:* Stainless steel. *Bezel:* Threaded to case. *Front:* Clear, extra-heavy glass set in channeled gasket to seal case. *Pointer:* Functional type, adjustable from front. *Stem:* Lengths – 4" to 24", 18-8 stainless steel. All joints welded. *Connection:* Fixed, ½" NPT. *Separable Sockets:* Available in all materials and sizes normally required.

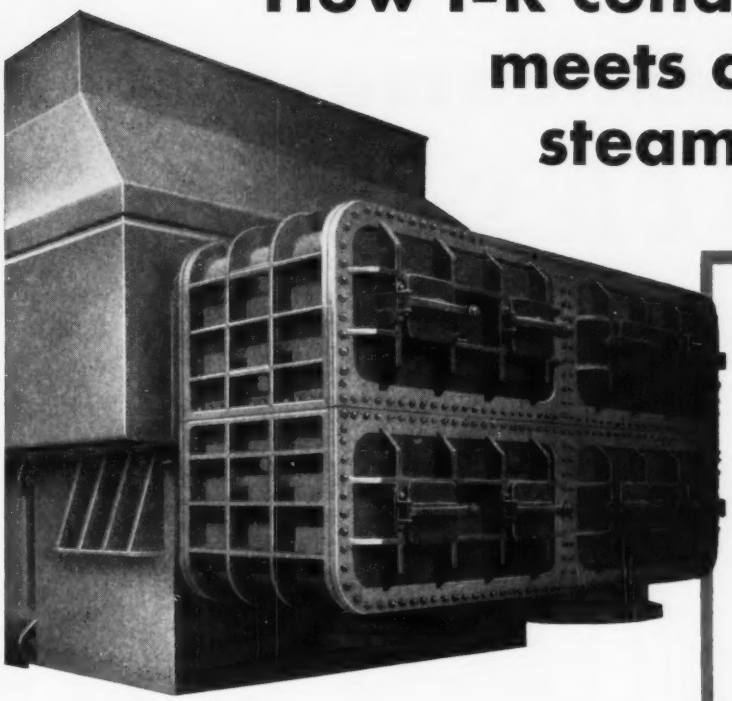
PHONE your Industrial Supply Distributor for experienced attention to your needs. He is always ready to help you ward off costly shut-downs through fast delivery from local stocks.

AMERICAN INDUSTRIAL INSTRUMENTS

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, *Stratford, Conn.* 'HANCOCK' VALVES, *Watertown, Mass.* 'CONSOLIDATED' SAFETY RELIEF VALVES, *Tulsa, Oklahoma.* AIRCRAFT CONTROL PRODUCTS, *Danbury & Stratford, Conn. and Inglewood, Calif.* "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Mich.*

How I-R condenser design meets all of today's steam plant needs

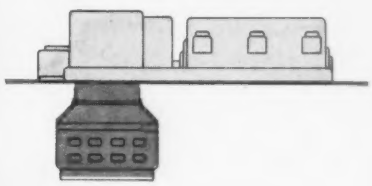


...Sets the pace in turbine-condenser adaptability

Permitting variations in condenser length, width and height without sacrificing performance, the Ingersoll-Rand rectangular design proves readily adaptable to all steam plant needs. Dimensional proportions can be changed over wide limits without departing from the basic standard arrangement of internal elements. This means maximum utilization of the condenser space available.

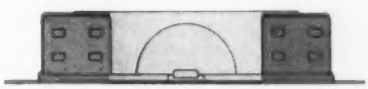
Continued refinements in I-R design are contributing to ever smaller space requirements for a given condensing capacity. These developments conform with the modern trend to higher turbine efficiencies and more compact turbine designs in reduced foundation areas for a specified kw rating.

Your I-R engineer will be glad to give you further information and submit recommendations to meet your particular requirements.



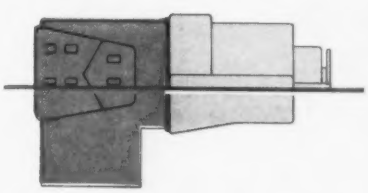
BOTTOM-EXHAUST TURBINE

Serving a 135,000-kw turbine, this condenser having 65,000 sq. ft. surface requires a headroom of only 14 feet 8 inches. It assures maximum economy of installation, operation and maintenance.



SIDE-EXHAUST TURBINE

Mounted on the turbine floor, the twin condenser shells of this I-R condenser are directly connected to the dual side exhausts of the cross-compound 191,000-kw steam-turbine.



AXIAL-EXHAUST TURBINE

Connecting directly to the exhaust of an axial flow exhaust turbine, this condenser of the single-pass rectangular type represents an outstanding example of I-R adaptability.

Ingersoll-Rand

4-457 11 Broadway, New York 4, N.Y.

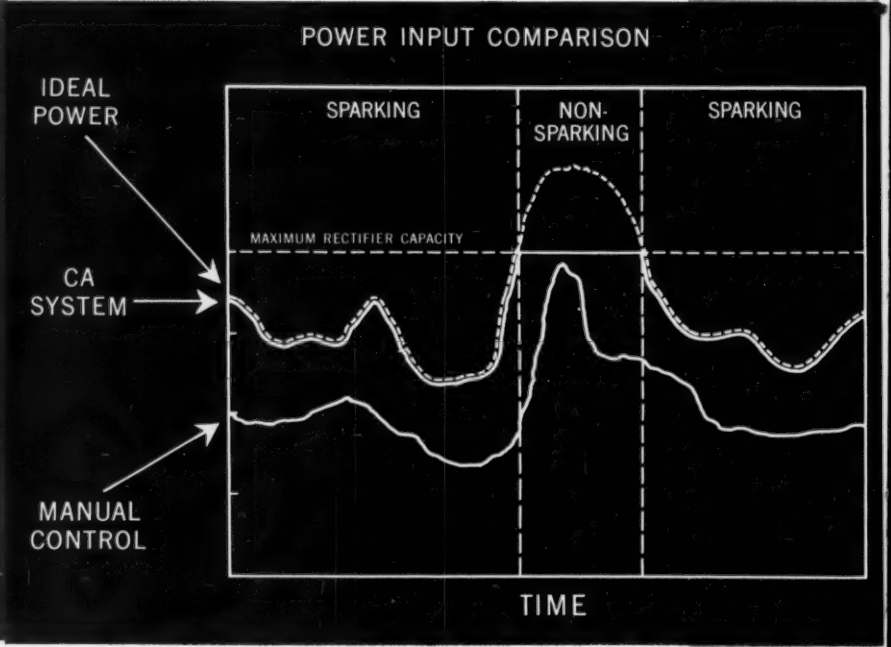
COMPRESSORS • TURBO BLOWERS • ROCK DRILLS • AIR TOOLS
CENTRIFUGAL PUMPS • CONDENSERS • GAS AND DIESEL ENGINES

RESEARCH-COTTRELL'S

New CA System brings Auto

to precipitators

Higher "around-the-clock" collection efficiency without any manual adjustments. That sums up the major advantages of Research's new Cottrell Automation System.



The chart at the left shows how the CA System provides these advantages. As you know, ideal electrical power input to a precipitator is not constant. It varies with changes in gas composition, temperature, rate of flow and humidity, as well as characteristics of the dust, such as size, electrical resistivity and extent of build-up on the electrodes. With conventional controls, manual adjustments cannot keep pace with these changing conditions. This difference between *ideal* electrical power and *actual* power input, under manual control, is shown in the chart. This

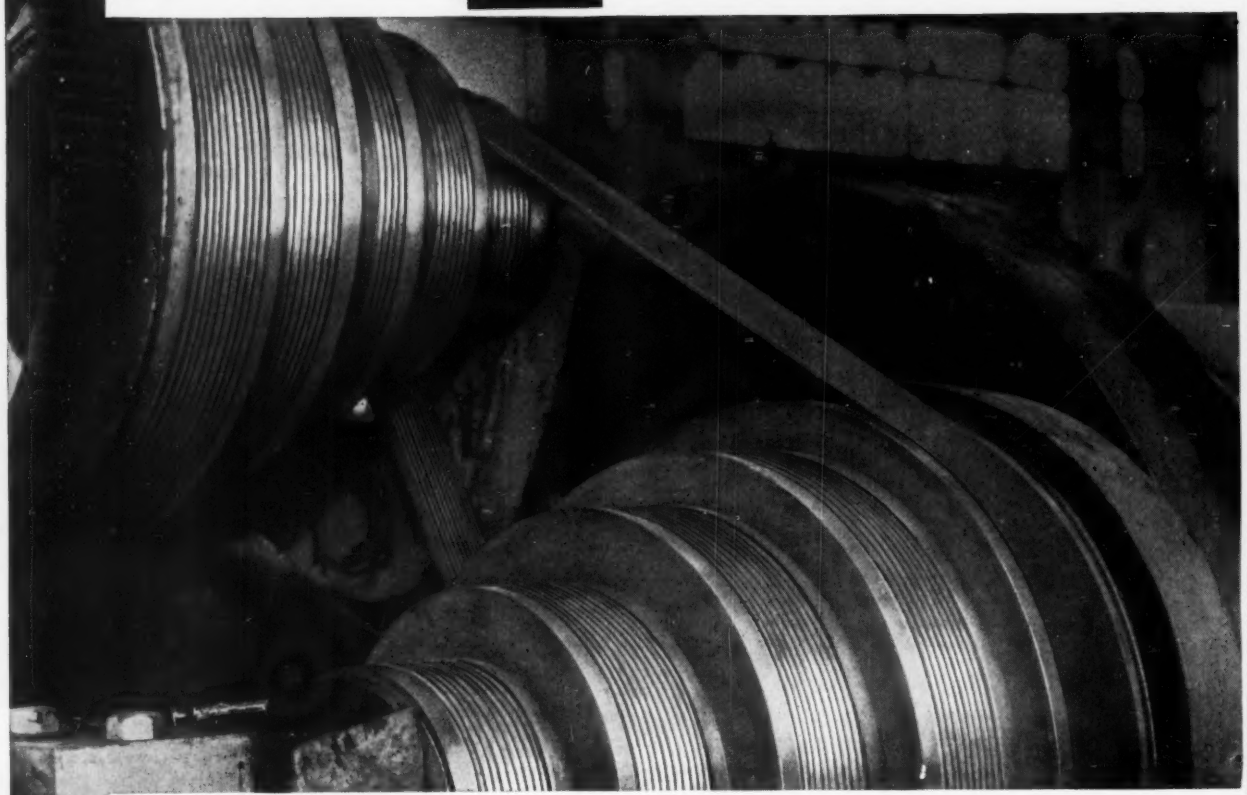
mation

difference means lower collection efficiency.
The fast acting electronic circuits of the CA System provide the best practical approach to ideal electrical power. During periods of sparking, electrical power input is controlled by the optimum sparking rate, which can be easily pre-set to any value between 0 and 500 sparks per minute. Under some conditions power input would have to be increased beyond the capacity of the electrical equipment in order to maintain this optimum sparking rate. During such periods the power input is governed by the *capacity* of the electrical equipment. This condition is shown in the center vertical section of the chart.
For more information on this new automation development write for your copy of Bulletin CA. It has a detailed description of how the Cottrell Automation System works and how higher "around-the-clock" collection efficiencies and lower operating costs are obtained.

Research-Cottrell

RESEARCH-COTTRELL, INC., Main Office and Plant: Bound Brook, New Jersey • 405 Lexington Ave., New York 17, N. Y.
Grant Building, Pittsburgh 19, Penna. • 228 No. La Salle St., Chicago 1, Ill. • 58 Sutter Street, San Francisco 4, Cal.

Users Say R/M BELTS AND HOSE



It's *Poly-V*® . . . and Trouble-Free!

Major causes of drive trouble have been engineered *out* of R/M's patented, new Poly-V Drive. Because it employs a single, endless V-ribbed belt running on sheaves specially designed to mate precisely with the belt ribs, Poly-V delivers more power per inch of drive width than ever before possible! R/M Poly-V delivers up to 50% more power than an ordinary V-belt drive of equal width . . . equal power in as little as ⅔ the width. This means *narrower sheaves . . . less shaft overhang . . . less drive weight* on heavy duty power driven equipment.

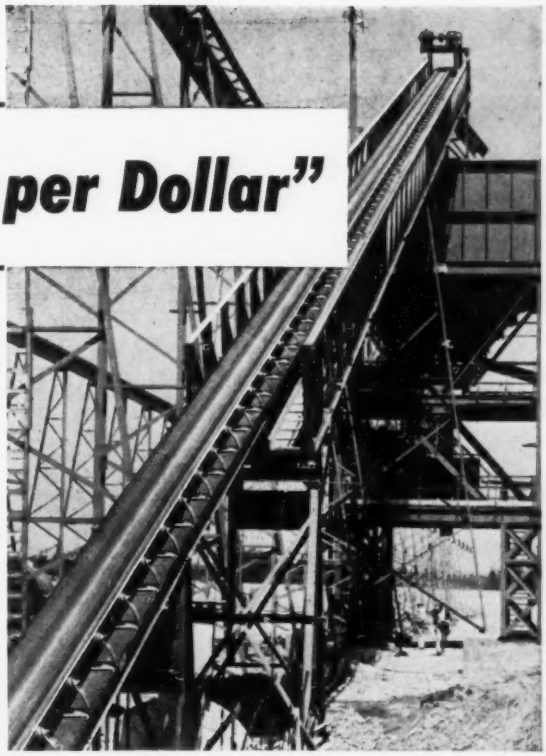
R/M Poly-V's single unit belt design also eliminates "length matching" problems and downtime for belt replacements. Poly-V belt speed ratio and belt position remain constant from no load to full load to run smoother and cooler — with *less wear* on belt *and* sheaves! Just two cross sections of Poly-V belt meet *every* heavy duty power requirement: belt and sheave inventories are cut to a new low!

An R/M representative will show you other features of Poly-V* Drive that add up to longer, trouble free service for every heavy duty power drive application.

Write for Bulletin #6638

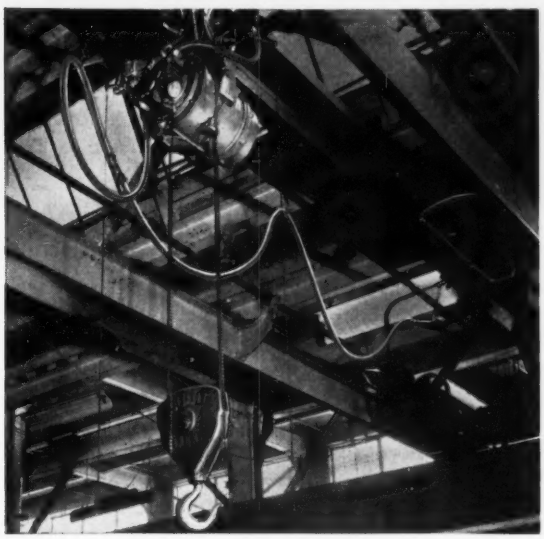
And . . . for the "Smoothest Running V-Belts Made" Specify R/M CONDOR and SUPER-POWER V-BELTS

Give You "*More Use per Dollar*"



Allflex Hose—Light, Strong, "Flexible as a Rope"!

This new R/M hose offers a degree of rugged strength with light weight and flexibility not possible with ordinary all-purpose constructions. Allflex hose coils and uncoils freely in *any* direction . . . *without kinking*. Uniform inside and outside diameters permit faster, easier, *safer* coupling. You can't find a longer lasting, easier handling hose for use with air, water, oil and gases—even mild chemicals!



R/M makes a complete line of quality hose for special services, too. Whatever your requirements, you get more use per *hose* dollar from R/M.

Write for Bulletin #7075

R/M Puts the "Extras" in Conveyor Belt Design!

For the conveyor belt *engineered* for your particular job, investigate R/M's advanced developments in heavy duty belt design . . . constructions like extra flexible Ray-Man . . . which trains naturally, troughs easily . . . handles *fuller, heavier* loads even where small pulleys are required in low-head room installations . . . extra-cushioned Homocord, for unusually abusive shock loading . . . R/M Tension-Master for extra long lifts and high tensions. Each belt is mildew-proof and moisture resistant . . . and each is protected by the exclusive "XDC" Cover, R/M's *bonus* extra to greatly increase resistance to wear, tear, cuts and abrasion. *Specify* R/M Conveyor Belts . . . you *get* "More Use per Dollar."

Write for Conveyor Belt Bulletins

RM 715

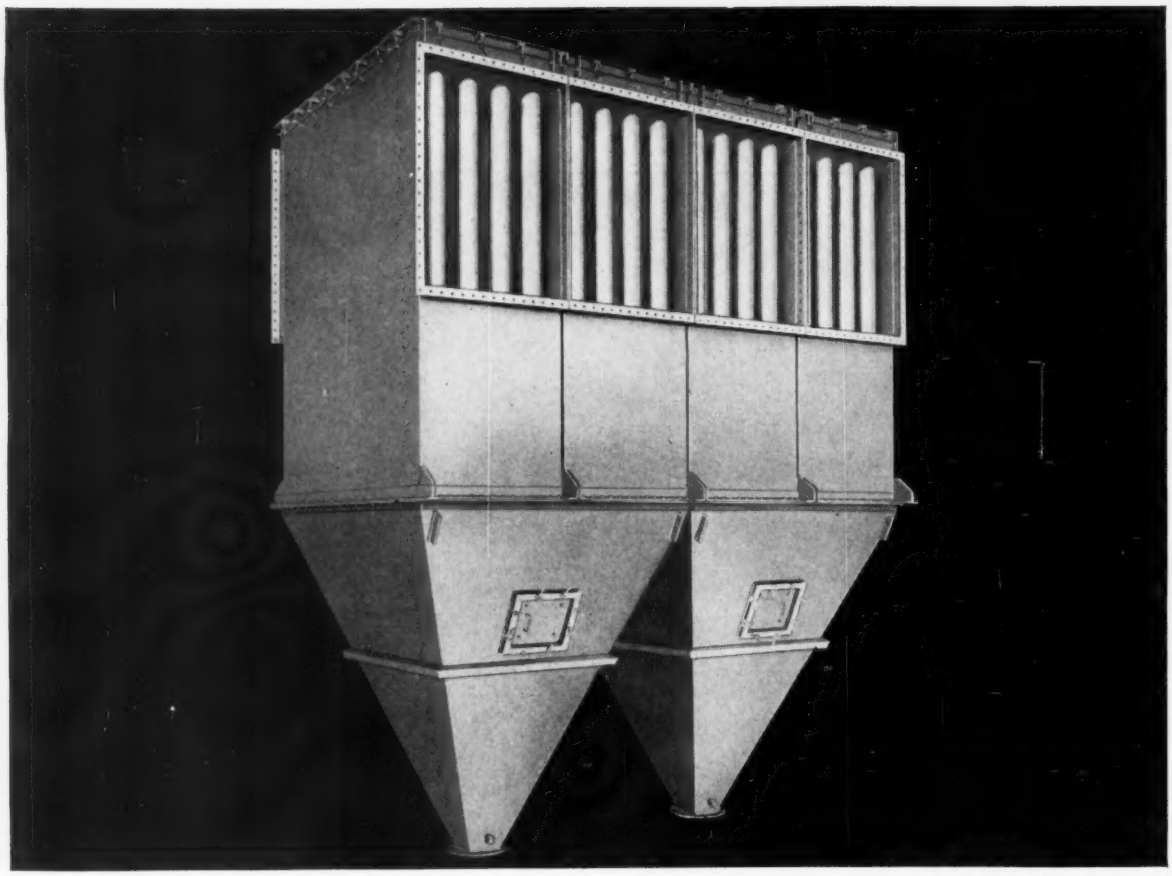
BELTS • HOSE • ROLL COVERING • TANK LININGS • INDUSTRIAL RUBBER SPECIALTIES

MANHATTAN RUBBER DIVISION — PASSAIC, NEW JERSEY

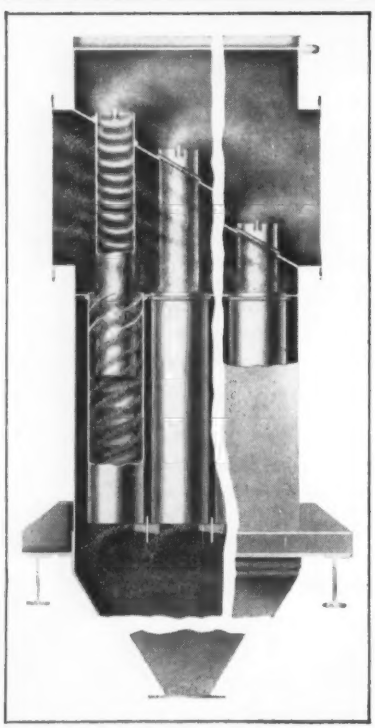
RAYBESTOS-MANHATTAN, INC.

Other R/M products: Abrasive and Diamond Wheels • Brake Blocks and Linings • Clutch Facings • Asbestos Textiles • Mechanical Packings • Engineered Plastics • Sintered Metal Products • Industrial Adhesives • Laundry Pads and Covers • Bowling Balls

Control fly ash with job-fitted



Series 342 Precipitator



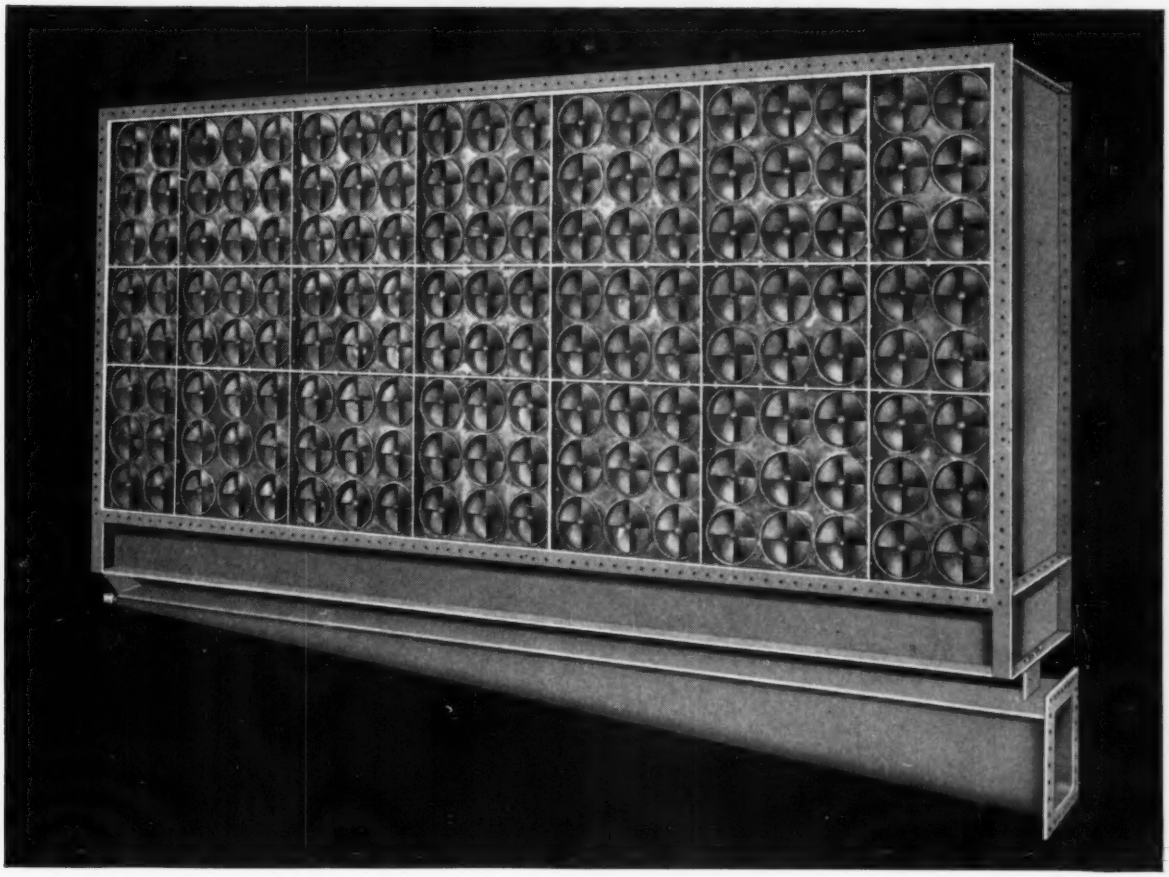
Dust-laden air or gas enters inlet plenum; gravity and centrifugal action force dust downward, adjacent to tube wall; dust is skimmed into gas-tight receptacle; cleaned air or gas moves upward through outlet tubes to outlet plenum.

COMPACT DUST COLLECTOR – Series 342 Precipitator meets industry's need for a simple, compact, economical, all-purpose, mechanical-type dust collector. With the growing value of fly ash as a salable by-product, adequate, efficient collection is becoming increasingly important.

Easy to install because of its sectionalized construction, the Series 342 Precipitator has proved effective in controlling dust discharge to the atmosphere in a large percentage of industrial plants. The reason: since each tube assembly is basically an individual cyclone or centrifugal dust collector, the multi-tube Series 342 will deliver an over-all performance comparable to the high efficiency obtained by a single, small-diameter cyclone.

Furthermore, American Blower Series 342 Precipitator features welded-steel construction and removable tubes, is available in a variety of sizes to meet specific job requirements on either new or existing installations.

American Blower precipitators

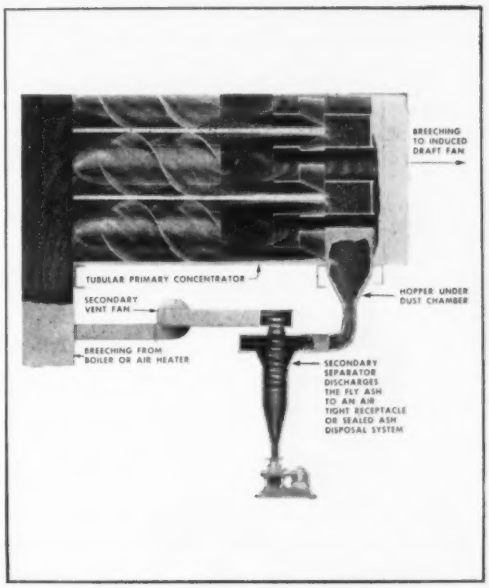


Series 361 Fly Ash Precipitator

FOR LARGE PUBLIC UTILITIES – Series 361 Fly Ash Precipitator offers maximum collection efficiency over entire operating range, occupies minimum space, and gives reliable performance, trouble-free operation.

What's more, the secondary separating system of the Series 361 makes it relatively more efficient at reduced loads when fly ash is finer and more difficult to remove. Then, too, ability to vary number and arrangement of individual cells makes it easy to tailor unit to the particular job.

Whatever your dust-collection problem, it will pay you to talk to an American Blower engineer. His knowledge of the application of precipitators and dust collectors can prove invaluable to you. Call your nearest branch, or write: American Blower Corporation, Detroit 32, Michigan. In Canada: Canadian Sirocco products, Windsor, Ontario.


BREECHING TO INDUCED DRAFT FAN
TUBULAR PRIMARY CONCENTRATOR
SECONDARY VENT FAN
HOPPER UNDER DUST CHAMBER
BREECHING FROM BOILER OR AIR HEATER
SECONDARY SEPARATOR DISCHARGES THE FLY ASH TO AN AIR TIGHT RECEPTACLE OR SEALED ASH DISPOSAL SYSTEM

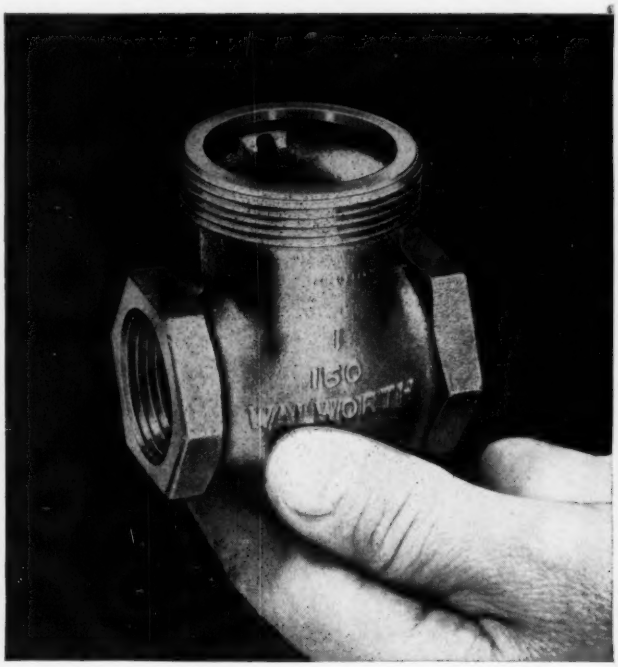
Secondary system results in velocity-efficiency characteristics which automatically maintain maximum efficiency over entire boiler load or operating range. Properly installed and operated, unit's collection efficiency is from 85% to 90%.

AMERICAN BLOWER

Division of AMERICAN-Standard

Here's what makes Bronze Valves

TYPICAL OF WALWORTH QUALITY is the union body-to-bonnet connection which stiffens the body against internal pressure; makes taking the valve apart a simple operation and reduces the chances of distortion or leakage even though the valve is repeatedly taken apart and reassembled. With this type of construction there is no possibility of the bonnet coming off the valve while the handwheel is being turned.



HEAVY BODY CONSTRUCTION is typical of *all* Walworth Bronze Valves. Extra-thick walls and rugged wrench hexes constitute a high safety factor and prevent distortion while the valve is being installed in the pipeline. Extra-deep pipe threads are accurately machined to eliminate leakage. Walworth Bronze Valves are also available with flanged, silver-brazed or soldered ends in certain sizes and types.

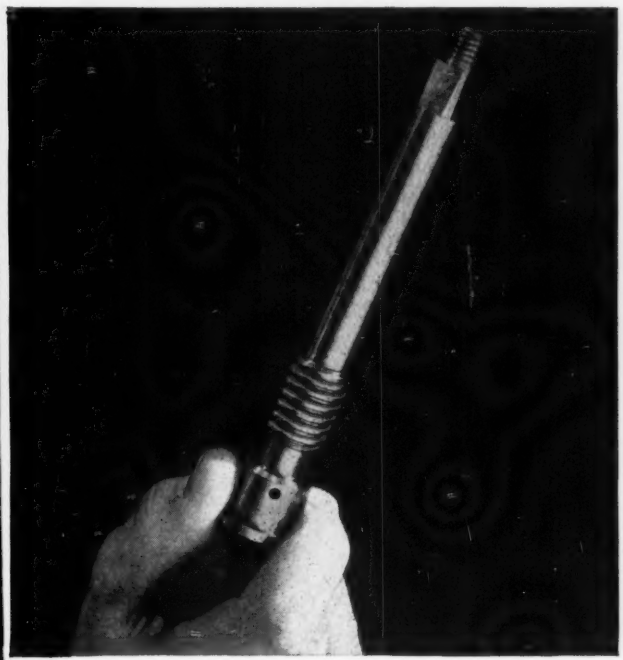
MEET THE CHAMP! The chief engineer of a midwestern plant had used a parade of valves in severe boiler blowdown service. Most didn't last longer than 60 days. None survived 90 days.

On the recommendation of a Walworth Representative the engineer installed the Walworth No. 225P Bronze Globe Valve shown here, stating that he would be entirely satisfied if it lasted a bare three months. Exactly 4 years and 362 days later the valve was taken out of service—not due to the wire drawing, steam cutting and galling which made the other valves short-lived—but because the highly turbulent steam finally wore a small hole in the body.

This is the kind of valve satisfaction you get—when you specify and use Walworth Bronze Valves. They are the longest wearing, toughest bronze valves on the market.

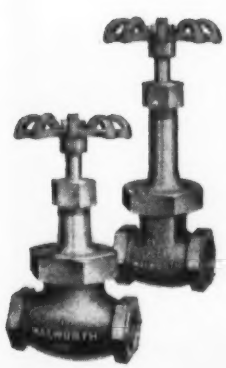
Walworth Subsidiaries: ALLOY STEEL PRODUCTS CO. • CONOFLOW CORPORATION • GROVE VALVE AND REGULATOR CO.

Walworth *the* real bargain!



EXTRA-LARGE STEMS with extra-long, extra-deep threads prolong valve life, protect against wear and distortion and provide tight positive shutoff. The surface of the stem is machined to a glass-like finish for minimum handwheel effort and to preserve the packing which results in fewer inspections and less maintenance. The top of the stem is tapered and squared to hold the handwheel securely.

TO REDUCE WIRE DRAWING to a minimum, certain types of bronze globe valves have stainless-steel plug-type seats and discs heat-treated to a nominal hardness of 500 Brinell, adding years to valve life even in severe services. These valves can be tightly closed on sand, grit or pipe scale without damage. Seats and discs are machined simultaneously, assuring perfect mating.



There is a Walworth Bronze Gate, Globe, Angle or Check Valve for every service. Walworth is continually developing new valve types and materials, including plastics, to keep pace with the growing variety and severity of services in modern industry. For full information, see your Walworth Distributor or write: *Walworth, 60 East 42nd Street, New York 17, N. Y.*

WALWORTH

Bronze Valves and Fittings

M & H VALVE & FITTINGS CO. • SOUTHWEST FABRICATING AND WELDING CO., INC. • WALWORTH COMPANY OF CANADA, LTD.

IS CORROSION EATING INTO YOUR CONDENSER'S EFFICIENCY?

When condensers operate at high capacities for long periods, tube failure occurs more frequently. Corrosion is accelerated by greater loads of water—carrying abrasives and debris—traveling at high velocities. The protective film normally formed by the metal is scoured away. Water can then act directly on tube walls—eating into your condenser's efficiency!

That's why the right copper-base tube alloy for your operating conditions—the alloy that gives the *best* corrosion resistance—can reduce your corrosion rate and frequency of re-tubing.

For example: *Service data and tests conducted in clean sea water show that Aluminum-Brass, Alloy #54, gives good service where water velocities are high. Where pollution exists, the best choices are Aluminum-Brass, Alloy #54, or Aluminum-Bronze, Alloy #53.*

When replacing old condenser tubes—or specifying new ones—be sure you take full advantage of all latest developments. Bridgeport Condenser Tube Alloys are matched to your corrosion conditions for longer life, reduced maintenance. Our Technical Service and Corrosion Laboratory will be glad to help you select the *right* alloy. Phone your nearest Bridgeport Sales Office today.

Write today for your free copy of Bridgeport's new Condenser Tube Handbook. Ask to be added to the mailing list for our Copper Alloy Bulletin.

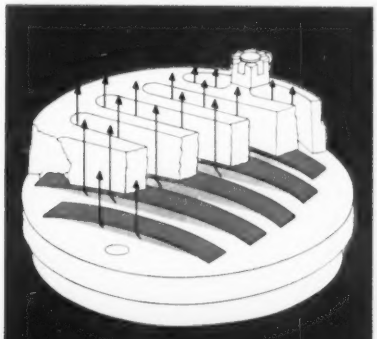
BRIDGEPORT CONDENSER TUBES

Bridgeport Brass Company, Bridgeport 2, Conn. • Offices in Principal Cities

In Canada: Noranda Copper and Brass, Limited, Montreal

Just a puff of air lifts the valve strip...

WORLD'S "FASTEST" COMPRESSOR VALVE!



Stainless steel strips, in red, open the Feather Valve ports by rolling contact against the lower plate. There is no impact.

It's not magic, merely a demonstration of Worthington's amazing Feather* Valve —the lightest, fastest-acting compressor valve on the market. Less than half a pound of air pressure will operate the valve in a standard two-stage 100 psi Worthington machine.

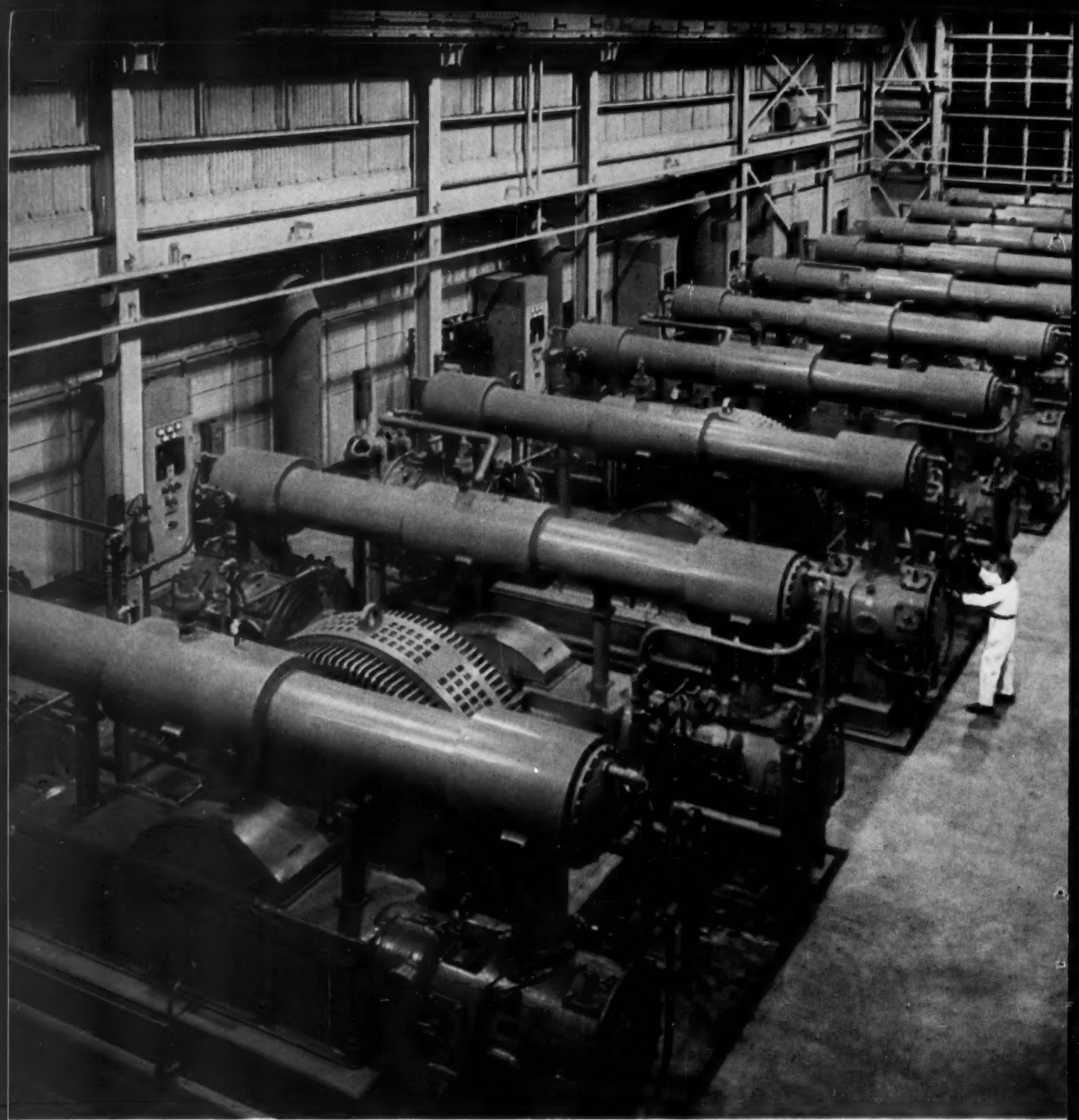
Because of its lightness and flexibility, Feather Valve action is very sharp. There is virtually no slip or back flow. Result: real savings in power costs.

No Impact. Even when operating as fast as forty times a second, the Feather Valve works with no impact. Lack of impact plus the absence of buffer plates and cushioning accessories assure long life and negligible valve maintenance.

For an on-the-spot report of a Worthington "Feather Valve" water-cooled compressor in action, see the next page.

WORTHINGTON

*Reg. U. S. Pat. Off.



Worthington Feather Valve air compressors operating at the Ford Motor Co. Plant, Cleveland, Ohio.*

HOW TO GET THE PLANT AIR COMPRESSOR YOU NEED

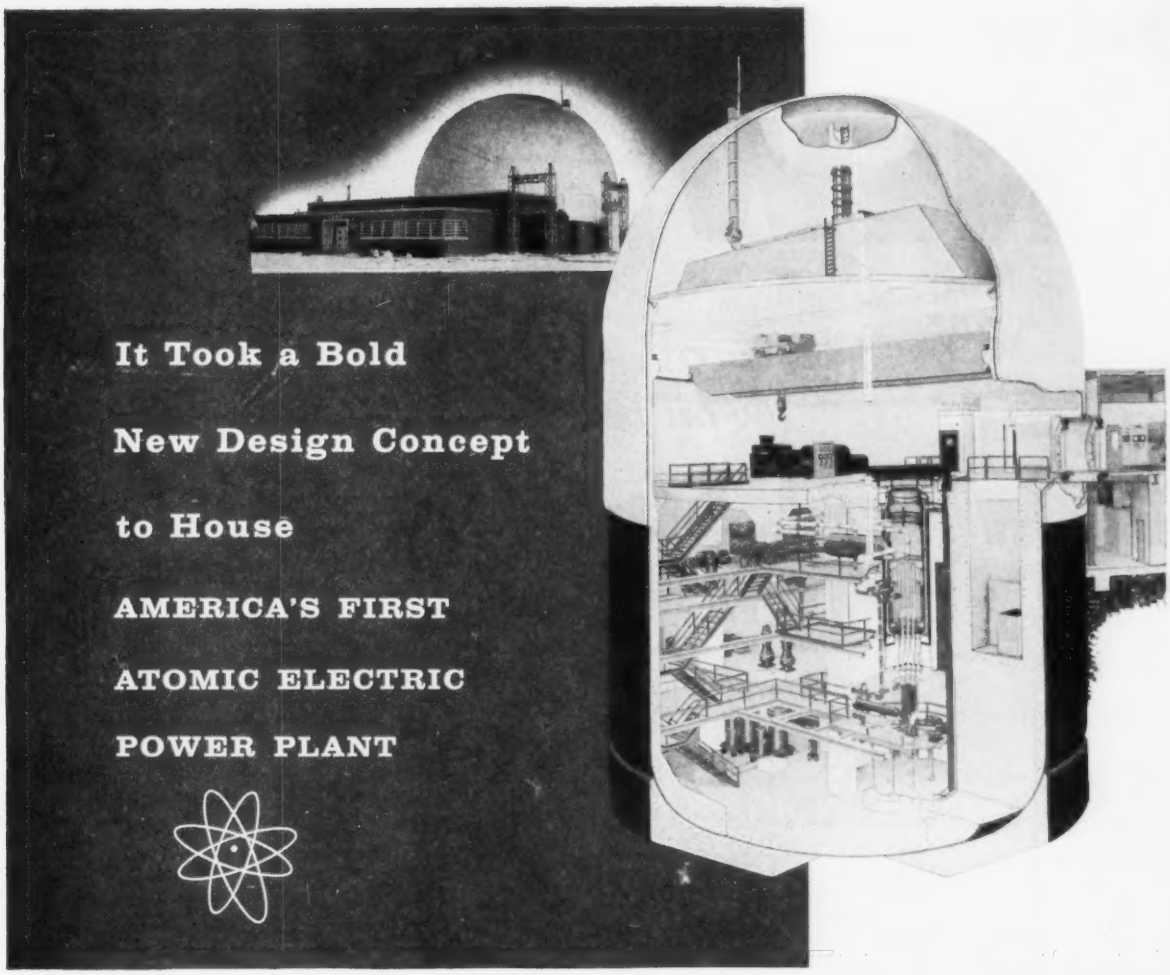
As in the above Ford plant, compressed air is a basic power service in most every modern industrial plant. Equipment reliability and long life are a must.

Worthington makes a complete line of water-cooled air compressors. Every machine is available in a standard unit, from the single horizontal "midgets" to the big balanced opposed "giants." This standardization allows complete freedom of choice and you can install these high quality machines at lowest possible cost in a surprisingly short time.

For more information about your compressed air needs, write Section K-71, Worthington Corporation, Harrison, New Jersey. In Canada: Worthington (Canada) 1955, Ltd., Toronto, Ont.

WORTHINGTON

See preceding page



How do you house an atomic electric power plant? Dig a hole five stories down. Erect a giant ten-story welded steel "containment vessel." Seal it off air-tight, and you have one of the largest pressure vessels man has ever been called on to build.

That's the story, over-simplified, of the unique housing required for America's first nuclear-powered electric plant, the Experimental Boiling Water Reactor, at Argonne National Laboratory, Lemont, Illinois.

In our practical, efficient world of engineering, there is a sound structural reason for the unusual dome-shaped building, now recognized by everyone as the symbol of atomic-power-for-peace.

Radioactive steam and gases must be contained within the system. The precautions necessary demanded an air-tight building, 80 feet in diameter by 119 feet high.

This giant welded steel structure, designed to withstand a pressure of 15 pounds per square inch above gage pressure, was made concave throughout, with a semi-ellipsoid bottom and a hemispheric top.

Upon completion, the half-million cubic foot shell was tested for air-tightness. Never before had so large a welded structure required such thorough testing against air loss.

Graver's skills, backed by a century of experience, were called upon to fabricate, erect and test this unique steel structure.

Graver's research department devised the special air-tightness testing procedures. Graver fabricated all sealing devices—the access air-locks, bulkheads and doors, and the two water-demineralizing systems. It also furnished the saucer-shaped 15,000 gallon water tank suspended under the dome.

This application of Graver's skills in the fabrication and erection of America's first atomic power plant is indicative of Graver's readiness to help you fulfill your plans for the future, no matter how unusual or exacting the requirements.

Building for the Future on 100 Years of Craftsmanship in Steels and Alloys

GRAVER TANK & MFG. CO., INC.

EAST CHICAGO, INDIANA • NEW YORK • PHILADELPHIA • EDGE MOOR, DELAWARE
PITTSBURGH • DETROIT • CHICAGO • TULSA • SAND SPRINGS, OKLAHOMA
HOUSTON • LOS ANGELES • FONTANA, CALIFORNIA • SAN FRANCISCO

GRAVER

NEW...and full of BIG features for you!

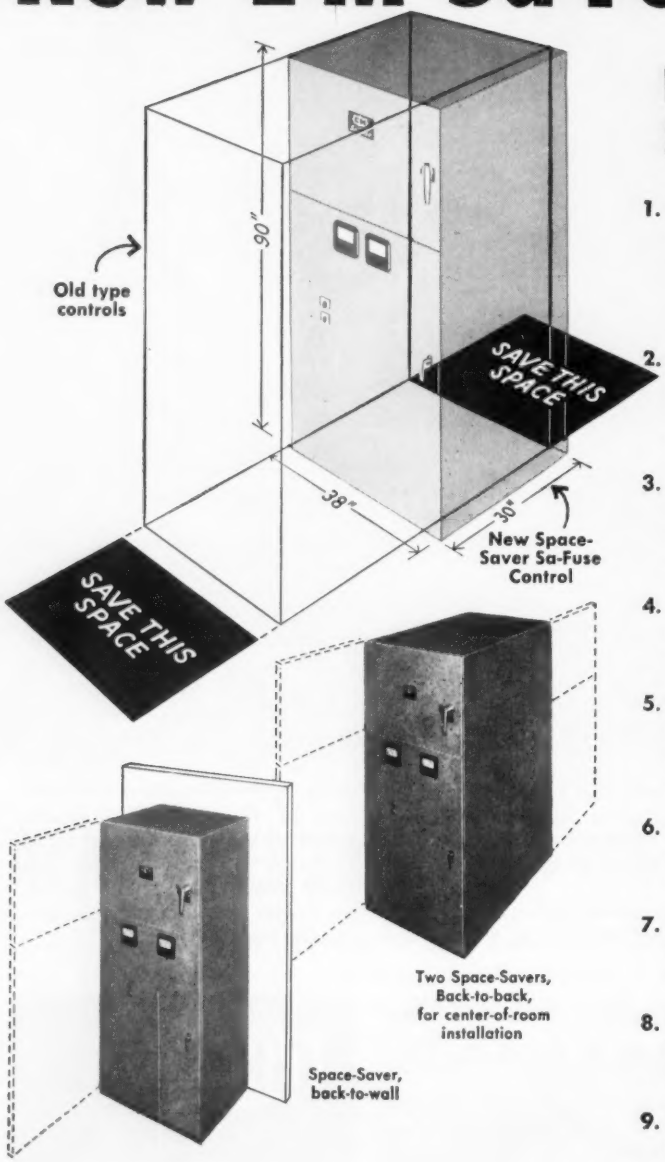
NEW

Space Saving
Safety
Easy Access
Easy Installation

CHOICE of Air or Oil Switch

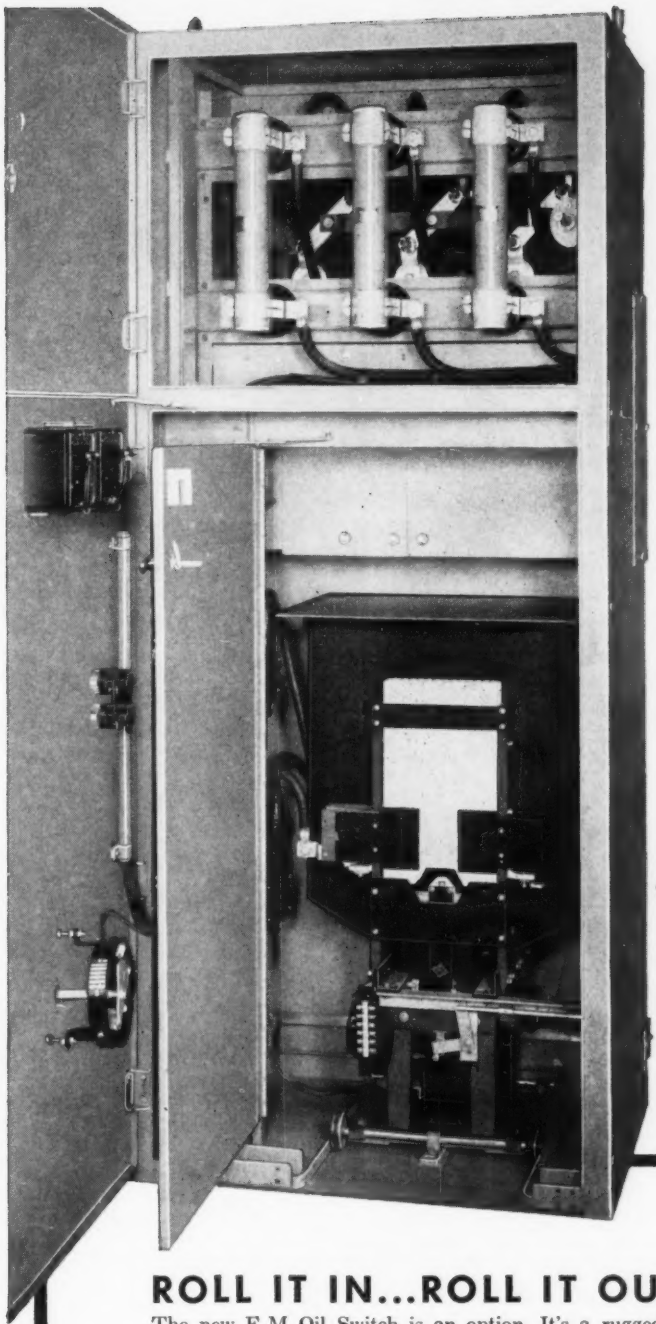
YOU GET THEM ALL IN THE

New E-M Sa-Fuse Control



✓ *Check these outstanding* SA-FUSE Features:

1. **CONTROL DEPTH CUT IN HALF.** The new Space-Saver SA-FUSE Control is only *half as deep* as old type controls. Space-Savers require no wasteful rear aisle. You get almost *twice as many* new Space-Savers into any given area.
2. **COORDINATED MOTOR PROTECTION.** Thermal relays and current-limiting fuses work together to protect against sustained overloads and short circuits.
3. **POLARIZED FIELD FREQUENCY RELAY,** invented by E-M, gives simplest, most foolproof, and most completely effective "conscious" control of synchronous motors.
4. **"SPOT CHECK" DISCONNECT SWITCH.** A glance at ganged disconnect switch quickly confirms that its blades are open and *grounded.*
5. **FOUR-WAY SAFETY INTERLOCK.** Personnel are guarded by interlocking between a-c contactor, disconnect switch door, disconnect switch, and contactor compartment door.
6. **ISOLATED HIGH VOLTAGE COMPARTMENT** is separated from low voltage chamber by a key-locked, hinged relay panel.
7. **FRONT-CONNECTED LOW VOLTAGE COMPONENTS** are mounted on front of hinged relay panel enclosing a-c contactor.
8. **RUGGED STEEL CABINET** is fabricated from heavy gage steel plate for extra strength and rigidity.
9. **VAULT-TYPE LOCKING.** Main door has 3-point locking for safety and freedom from vibration.

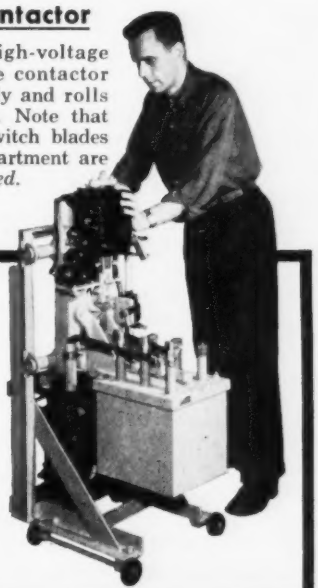


Complete front-of-control accessibility

Cable pulling is easier in the big, roomy high-voltage compartment. Power cables enter through top or bottom of cabinet.

Here's Sa-Fuse with roll-out air-break contactor

Isolated in the high-voltage compartment, the contactor disconnects easily and rolls out for servicing. Note that the disconnect switch blades in the fuse compartment are open and *grounded*.



ROLL IT IN...ROLL IT OUT!

The new E-M Oil Switch is an option. It's a rugged oil switch specially designed for motor starting duty. Control transformer is mounted with it on roll-out assembly.

When you're thinking about motor controls, be sure to ask your E-M Sales Engineer about SA-FUSE. He will be glad to give you details about the better motor control. Also, write today for your personal copy of the informative SA-FUSE brochure, No. 1133.

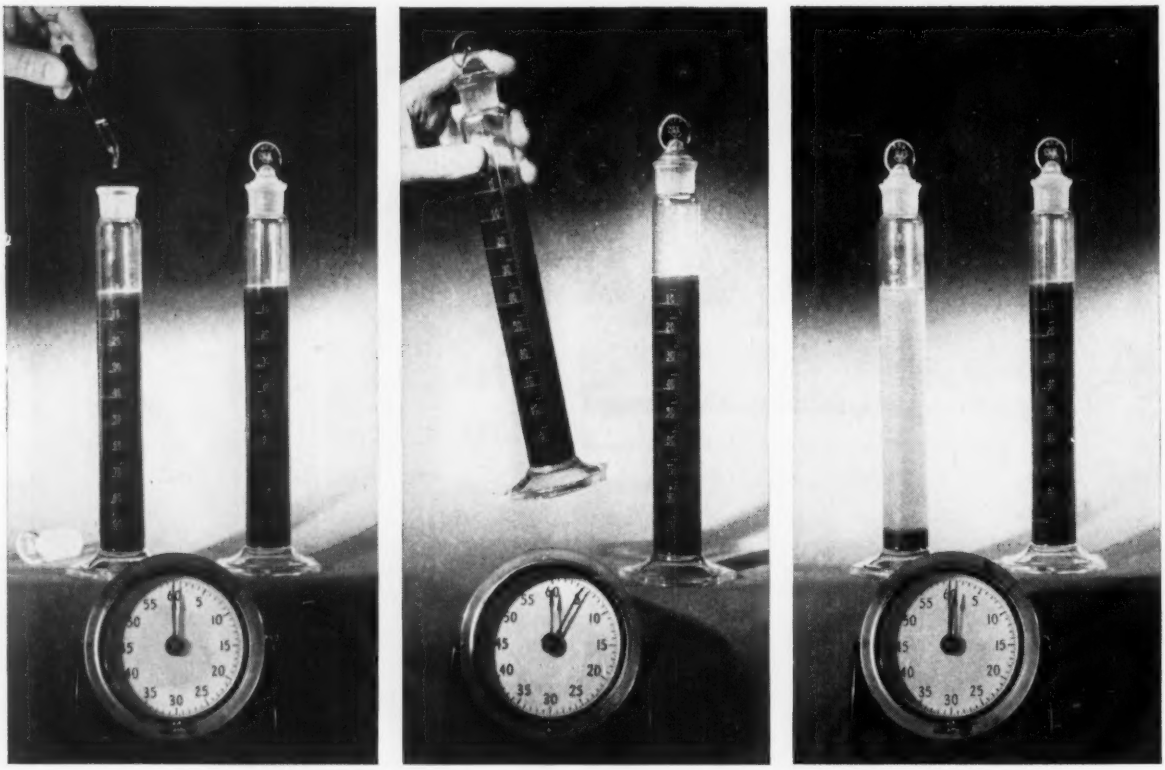
E-M

ELECTRIC MACHINERY MFG. COMPANY

Minneapolis 13, Minnesota

Originators of the safety gang disconnect high-voltage fuse control

3300-TPA-2156



Demonstration: Add Separan 2610 . . . mix . . . in a few seconds, solids settle . . . compare with untreated solids.

New flocculating agent Separan 2610 clears process and waste water in record time

New flocculant proves to be faster and more economical answer to many old problems in process water and waste treatment operations. Separan 2610® speeds up settling and filtration rates . . . brings many other improvements to liquid-solid separations!

PROVEN APPLICATIONS

Process water treatment – improves throughput and performance in hot and cold lime softeners, chemical flocculation units!

Sewage–speeds dewatering of digested elutriated sewage sludge!

Oily waste disposal – improves floc blanket flotation on refinery water effluent flotation unit!

Foundry waste–reduces stream pollution and provides cleaner recycle water!

Pulp & paper waste–increases solids recovery, lowers sewer loss!

Coal washing–improves fines recovery, increases throughput of settling unit!

Electroplating–settles solids in combined cyanide, chrome and acid wastes; speeds filtering!

Chemical wastes–improves solids recovery; less material loss!

EXAMPLES OF RESULTS

Separan 2610 was applied at 0.25 ppm to a cold lime softener supplying cooling tower make-up water. The sludge blanket became stabilized, effluent turbidity was reduced from an average 10 ppm to less than 5 ppm, and the unit operates more efficiently. Flocculant savings with Separan 2610 exceed $110 per month on a throughput that averages 900 gpm.

Another plant uses Separan 2610 in dewatering of digested elutriated sewage sludge on vacuum filters. This application has brought a 24% increase in filter capacity and a 20% reduction in total chemical flocculant cost.

In oil refineries, similar improvements are being experienced in flotation units for clarification of combined oily wastes. By adding 0.5 ppm Separan 2610, along with alum, to waste water in a flotation unit, plants have improved floc blanket stability and reduced the oil content of the effluent.

MANY APPLICATIONS HAVE BEEN TESTED

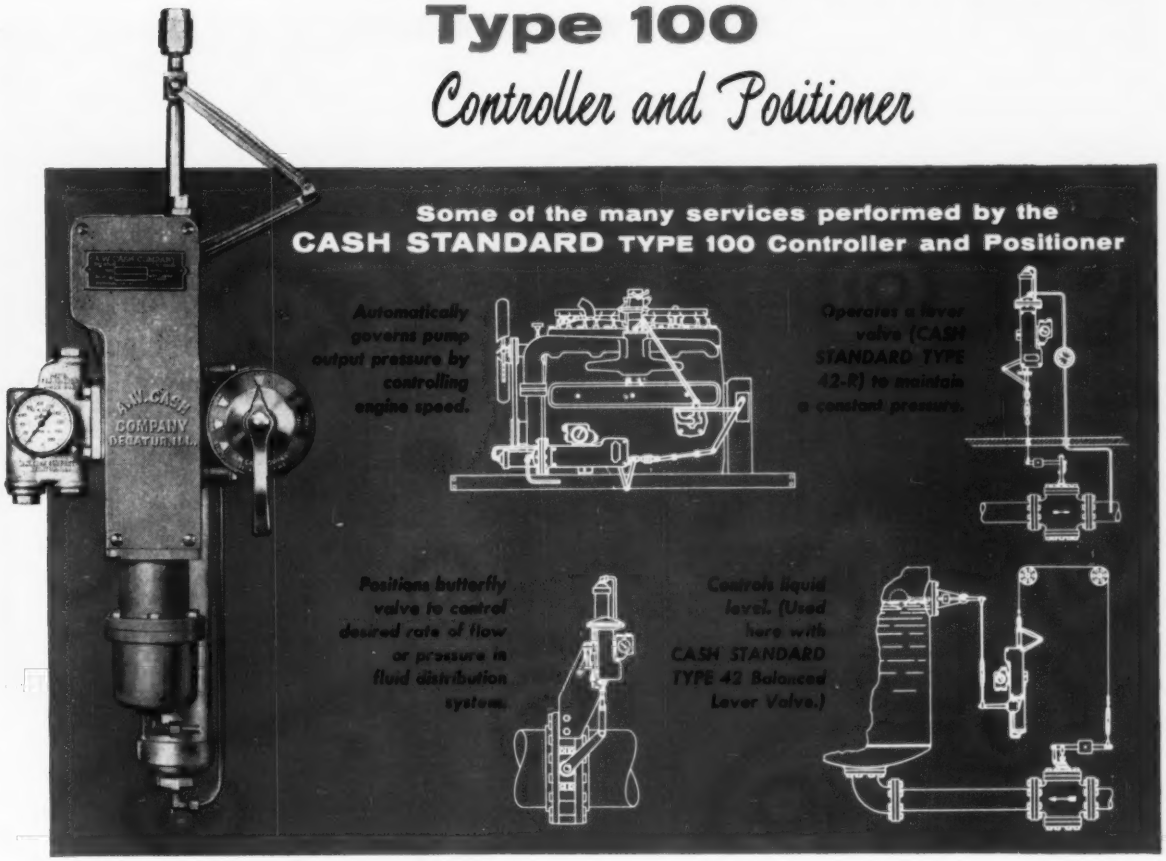
Separan 2610 has shown excellent results in many waste and process water applications. It is an organic flocculating aid that is easy to prepare and apply, noncorrosive, and that presents no hazard in normal handling and industrial use. Samples and technical assistance are available by writing us. For further data, request one of our new booklets on Separan 2610 in "Waste and Sewage", "Water Treatment", "Coal Industry", or "Pulp and Paper". THE DOW CHEMICAL COMPANY, Midland, Michigan, Dept. SC1321J.

YOU CAN DEPEND ON DOW

automatic control or positioning problem?

Here's the answer . . . the versatile

CASH STANDARD
Type 100
Controller and Positioner


Some of the many services performed by the
CASH STANDARD TYPE 100 Controller and Positioner
Automatically governs pump output pressure by controlling engine speed.
Operates a lever valve (CASH STANDARD TYPE 42-R) to maintain a constant pressure.
Positions butterfly valve to control desired rate of flow or pressure in fluid distribution system.
Controls liquid level. (Used here with CASH STANDARD TYPE 42 Balanced Lever Valve.)
A.W. CASH COMPANY DECATUR, ILL.

include this unit in your process system as:

1. A controller with self-contained positioning mechanism.
2. A power positioner actuated by a signal from another controller.

The Type 100 coupled with various types of final control elements will accurately control:
• Pressure • Liquid level • Rate of flow • Other process variables

The Type 100 features: • Feed back type control • Adjustable range • High sensitivity • Linear or curved line characteristics • Reverse or direct action • Optional manual control • Double acting cylinders, 6″ or 12″ stroke, 2″, 2¾″ or 4″ bore for operating pressures up to 125 psi. (Also suitable for larger cylinders in combination with volume booster when higher thrusts are desired.) • Operation by air, oil or clean water.

Available for these signal ranges: • Vacuum • Differential pressure • Pressures up to 600 psig. • Lever motion

WRITE TODAY for complete information, including literature, on this versatile instrument. Dept. E.

CASH STANDARD

A. W. CASH COMPANY, P. O. Box 551, Decatur, Illinois

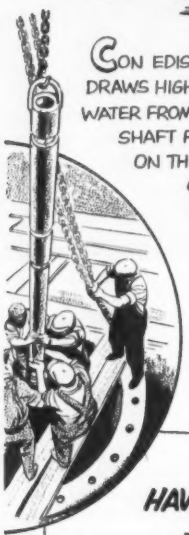
Pressure, Hydraulic, Temperature, Process and Combustion Controls

POWER POINTERS

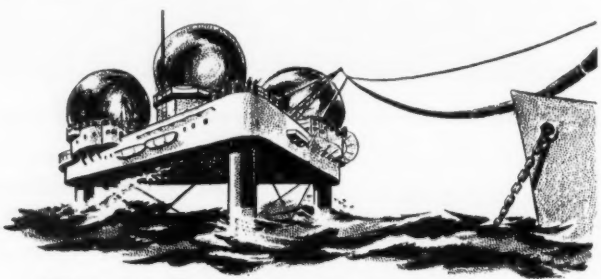
5,000 Miles

OF MONEL SEAMLESS TUBING!

A NEW COLD-DRAW SECTION OF INCO'S HUNTINGTON WORKS IS CAPABLE OF TURNING OUT 5,000 MILES OF SEAMLESS MONEL* TUBING A YEAR. MORE THAN ENOUGH TO GO THE FULL LENGTH OF THE AMAZON RIVER! THE 85-FOOT LENGTHS ENABLE ENGINEERS TO TAKE ADVANTAGE OF GREATER HEATING AREA IN FEEDWATER HEATER TUBE BUNDLES, AND TO EFFECT ECONOMIES BY SPECIFYING LONGER HEATERS OF SMALLER DIAMETER!



CON EDISON'S NEW ASTORIA STATION DRAWS HIGHLY CORROSIVE, SALTY COOLING WATER FROM THE EAST RIVER. TO PREVENT SHAFT FAILURE FROM CORROSION ON THE FOUR 68,500 GPM PUMPS, CON EDISON ENGINEERS SPECIFIED "K" MONEL* AGE-HARDENABLE NICKEL-COPPER ALLOY SHAFTS.



Sturdy "sea legs" under a Man-Made Island!

SHEATHED IN MONEL, THE LEGS OF OFFSHORE RADAR PLATFORMS ARE PROTECTED FROM DANGEROUS CORROSION IN THE VICINITY OF THE WATERLINE. MONEL RESISTS SALT WATER...SALT AIR...SALT SPRAY. A NATURAL CHOICE FOR HANDLING BRACKISH AND CORROSIVE COOLING WATERS.

HAVE YOU A METAL PROBLEM?

THEN FIND OUT MORE ABOUT MONEL. HOW IT CAN HELP YOU EXTEND EQUIPMENT LIFE... REDUCE MAINTENANCE COST. WRITE FOR BULLETIN,

"ENGINEERING PROPERTIES OF MONEL"

IT'S FREE ON REQUEST.

THE INTERNATIONAL NICKEL COMPANY, INC.

67 Wall Street — New York 5, N. Y.

INCO TRADE MARK **Nickel Alloys** *Registered Trademark

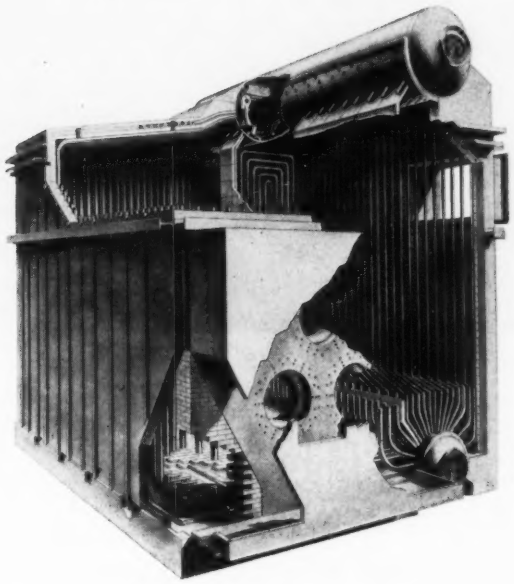
More POWER for you . . . with MONEL

Here's why you get

IMPORTANT SAVINGS in

- ✔ *first cost*
- ✔ *installation*
- ✔ *operation*
- ✔ *maintenance*

with the FW Series "SC" STANDARD BOILER

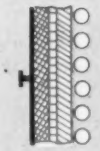


THESE nine Foster Wheeler design features add up to substantial savings in the cost of steam generation. Equally important is the extra *dependability* that's built into every "SC" unit – the result of over 60 years of experience in the design and construction of large, high-pressure steam generators for leading central station power plants.

Pre-engineered in all details and standardized for economy, these FW standard steam generators are available for oil or gas firing, in capacities from 50,000 to 150,000 lb/hr, for pressures to 1500 psi and superheated steam temperatures to 950 F. For complete information, send for Bulletin B-55-4. *Foster Wheeler Corporation, 165 Broadway, New York 6, N.Y.*

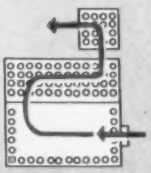
1. COMPLETELY WATER-COOLED WALLS

All furnace walls are cooled by closely-spaced tubes, minimizing setting maintenance and preventing excessive exit gas temperatures.



2. EFFICIENT FIRING ARRANGEMENT

Burner arrangement assures maximum rating without overheating furnace tubes. Rear wall is over 19 ft. from burner wall, permitting long, horizontal flame travel.



3. FULLY DRAINABLE SUPERHEATER

A completely drainable superheater permits removal of all condensed water from the elements before start-up.

4. HIGH STEAM PURITY

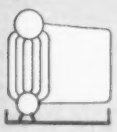
The normal drum internals consist of chevron dryers and a dry box. Separators may be added which make possible a steam purity of 1PPM or less.

5. UNRESTRICTED CIRCULATION

Absence of headers provides free circulation through integral risers and downcomers, eliminating header handhole plates and gaskets.

6. BOTTOM SUPPORTED UNIT

The bottom-supported design fully utilizes the structural strength of the tubes and provides low unit stresses in all members.

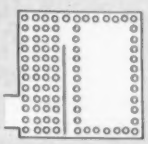


7. PRESSURE-TIGHT CASING

The all-welded casing forms a rigid, pressure-tight unit that can be arranged for pressurized or balanced draft operation.

8. MINIMUM REFRACTORY BAFFLING

The wall separating furnace and boiler bank is the only refractory baffling used. It is completely accessible from the furnace.



9. SIMPLE SOOT BLOWER ARRANGEMENT

Soot blowers are supported on the outer row of boiler-bank tubes, simplifying alignment and providing easy access.

FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

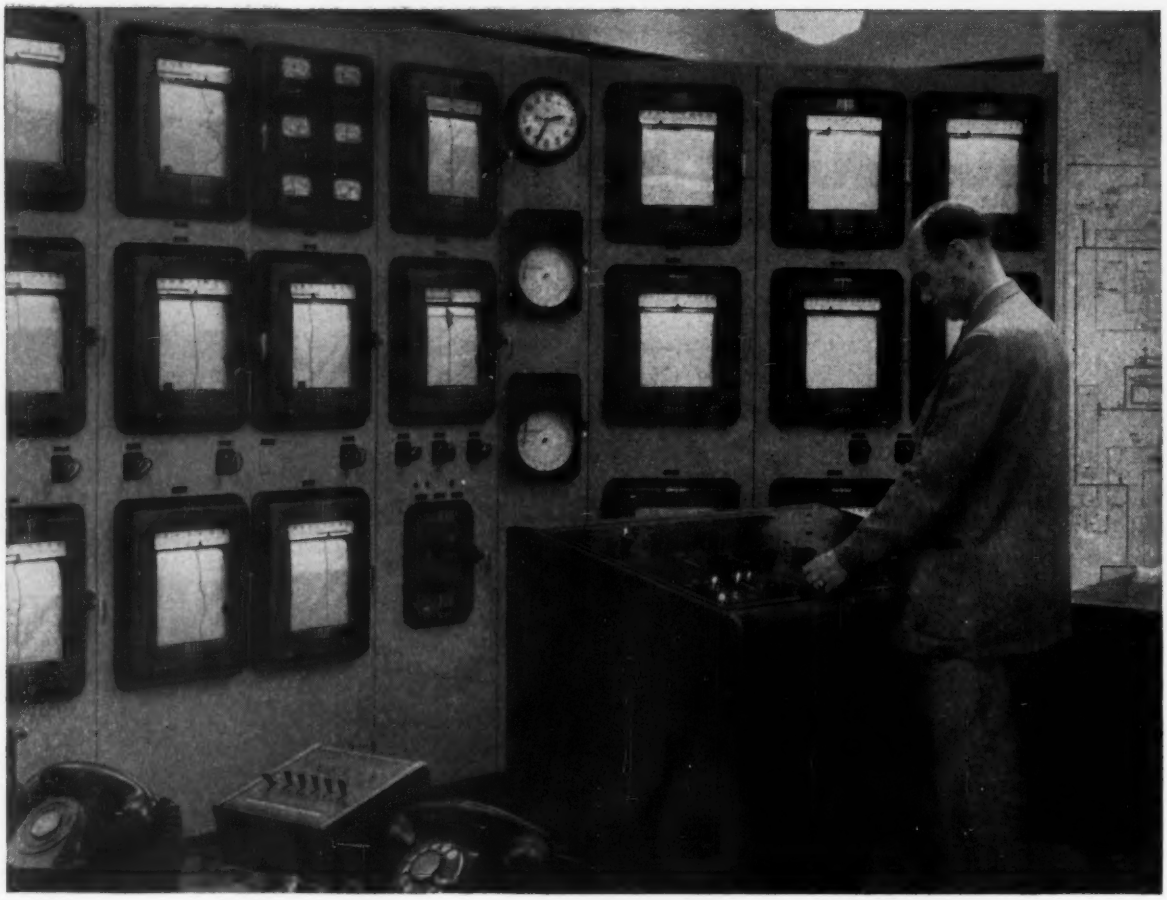


Photo courtesy Public Service Co. of Oklahoma

He's Using an "Idea Amplifier" to solve a cost-cutting problem

This Load Dispatcher's aim at the moment is to coordinate regulation of hydro and steam generation. On paper at least, this coordination contributes to lowest-cost operation, but in actual practice, its execution involves numerous factors —many of them variables, and far too complex to be calculated manually in a hurry.

So the Dispatcher turns to electronics for amplification and execution of his idea. He uses the console in front of him to convert it to an electrical equivalent which is instantly calculated and telemetered in the form of control pulses to any given number of turbine governor motors simultaneously . . . and it's all done with cost-cutting accuracy beyond the ability of even the best manual operation.

The "amplifier" in this case is an Area Load Control console—a device with computing circuits that functions as the brain of each Leeds & Northrup Area Load Control system. Already, these custom-engineered systems are installed on utility networks accounting for nearly a *third* of American generation.

Operating flexibility of Area Load Control is one reason for this preference. For when day-to-day operating conditions change (due to wet coal, loss of a cooling fan, unscheduled maintenance, etc.) Area Load Control provides the Load Dispatcher with the necessary flexibility to meet these problems as they arise.

Next time you have an opportunity, talk with your power neighbors who use Area Control—get the benefit of their thinking plus the ideas of your own operating staff. It's a method for turning in cost-cutting recommendations that work.

EBWR

"Today marks an event of historic significance in man's development of the atom for peaceful purposes. The reactor we are placing in operation today is the first of a generation of such reactors designed to provide electric power for our factories and our homes, power upon which the strength and future well being of this country vitally depends."

from Dedication address, Feb. 9, 1957, by Rep. Carl T. Durham, Chairman, Joint Congressional Committee on Atomic Energy.

EXPERIMENTAL BOILING WATER REACTOR PLANT

Argonne National Laboratory
Lemont, Illinois

TURBINE RATING
5000 kw—600 psig—488° F

ENGINEERING AUTHORIZED
August 25, 1954

FULL POWER GENERATION
December 29, 1956

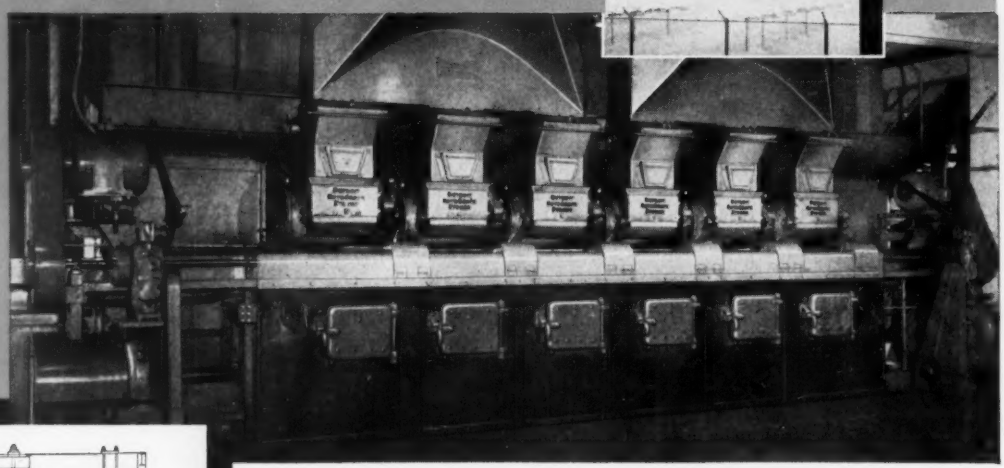
FORMAL DEDICATION
February 9, 1957

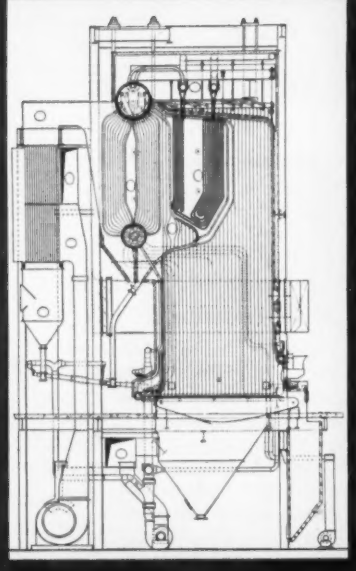
SARGENT & LUNDY ENGINEERS

140 SOUTH DEARBORN STREET, CHICAGO 3, ILLINOIS

Mile High Plant Steam Generator Fired By DETROIT ROTOGRATE STOKER

Southern Colorado Power Co.





Southern Colorado Power Co.
Canon City, Colorado
W. C. Porter, Vice President in Charge of Operations
Chester Huskey, Superintendent

Stearns-Roger Manufacturing Co., Denver
Engineers—Constructors
Loeb & Eames, New York, Consultants

This new unit which triples the capacity of the plant consists of a Babcock and Wilcox two-drum single pass steam generator fired by a Detroit RotoGrate Stoker having six feeders and distributors. The plant is at 5,300 feet above sea level. Capacity of above unit is 150,000 pounds of steam per hour at 860 psi, 915° steam temperature with preheated air at 350° F.

Design is based on bituminous coal:

B.T.U. per lb as fired	10,828
Moisture	8.84%
Volatile matter	33.72%
Fixed Carbon	44.69%
Ash	12.75%
Sulphur (separately determined)	0.7%

However, operation has been completely successful with coal from various mines in the vicinity.

Detroit RotoGrate is an exceptionally efficient spreader stoker with overlapping highly restricted grates that move slowly forward discharging ash at the front. Permits high burning rates with all Bituminous coals, Lignite or refuse fuels. *Write for Bulletin.*

DETROIT STOKER COMPANY

MAIN OFFICE AND WORKS MONROE, MICHIGAN
District Offices or Representatives In Principal Cities

OTHER TYPES AND SIZES OF DETROIT STOKERS FOR EVERY INDUSTRIAL OR POWER NEED

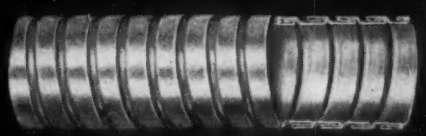
EXTRA HEAVY DUTY

HEAVY DUTY

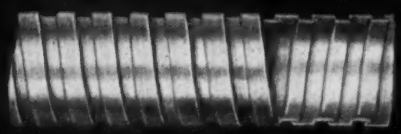
LIGHT DUTY

MEDIUM DUTY

PENFLEX



LIGHTWEIGHT EXHAUST



SQUARE LOCKED CASING

RUGGED FLEXIBILITY

FOR EVERY INDUSTRY'S REQUIREMENTS

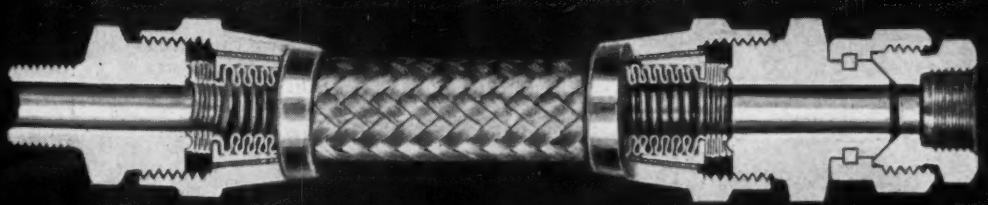
Tough as a pipe, but flexible, that is Penflex tubing. You name your need for conveying volatiles, liquids, chemicals, powders, granular materials, or semi-solids . . . hot or cold . . . and Penflex has the right tubing to provide the maximum service. It is unsurpassed for withstanding rough abuse, abrasion, crushing and heat.

Squarelocked, interlocked, corrugated . . . packed or unpacked . . . braided or unbraided . . . with all types of couplings. Penflex makes them to meet your exact specifications and scientifically engineers them to the installation with "Flexineering." If you need flexible metal tubing from ⅛" to 24" I.D. . . . bronze, galvanized or stainless steel call on your Penflex man. For data on the complete line of products . . . plus valuable specifications on flexible tubing write for your copy of "Flexineering."

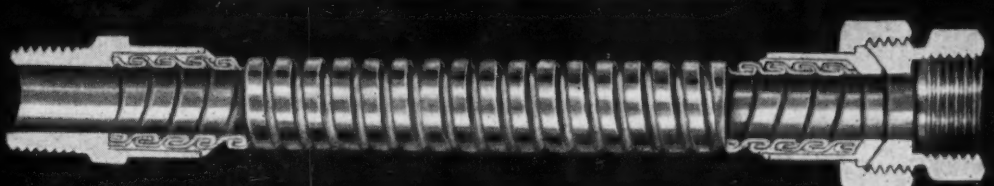
PENNSYLVANIA FLEXIBLE METALLIC TUBING COMPANY, INC.

7237 POWERS LANE, PHILADELPHIA 42, PA.

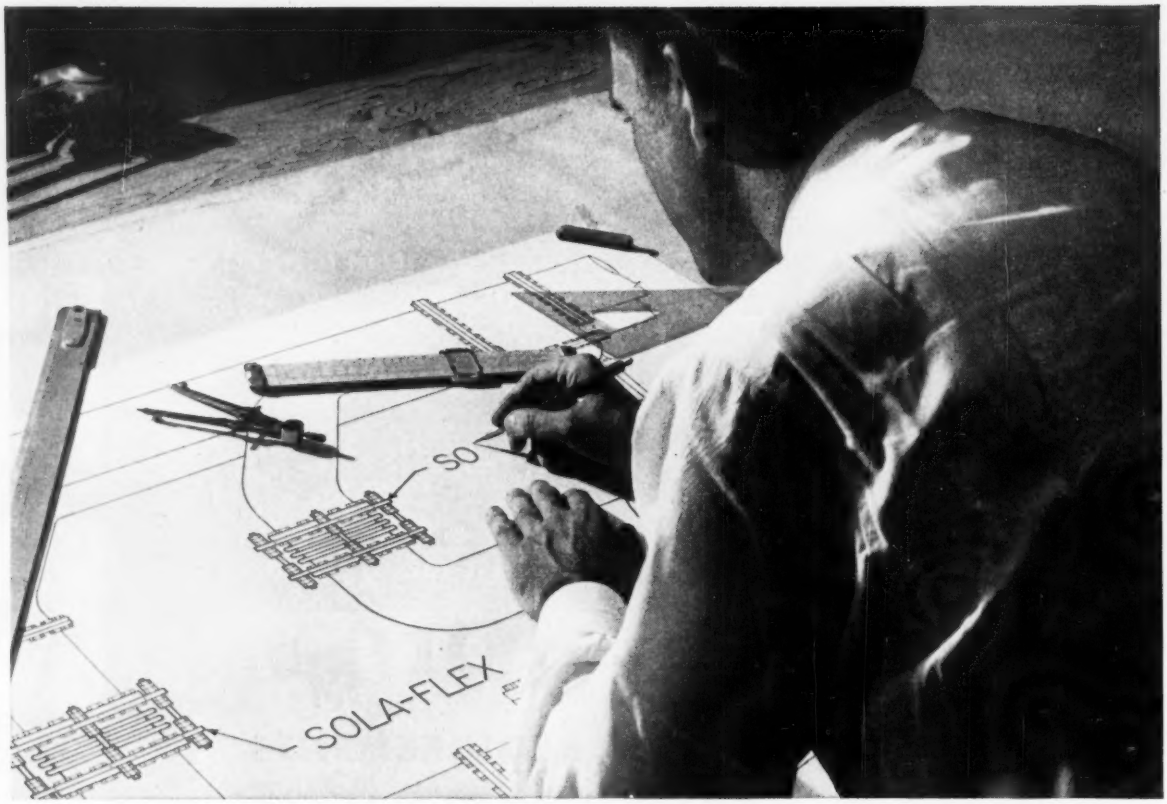
Branch Sales Offices: Boston New York Chicago Houston Cleveland Los Angeles
and Distributors in Principal Cities



PENFLEXWELD WITH HEATPROOF COUPLINGS



M-100 WITH SOLDERED COUPLINGS



In piping "specs" specify Sola-Flex

SOLAR SOLA-FLEX®

EXPANSION JOINTS AND BELLOWS
MADE IN ALL SIZES AND VARIETIES

YOU BENEFIT many ways when you call for Sola-Flex expansion joints in a high or low pressure piping installation. Durable and economical, Sola-Flex joints are custom-engineered, based on advanced designs perfected by Solar. They are built of a variety of metals in a vast array of sizes, shapes and configurations. And Sola-Flex joints have been proven in service—in all types of installations throughout the petroleum, utility, chemical, petrochemical, and other industries.

Send for the latest Sola-Flex catalog—many pages of valuable data. Write Dept. C-147, Solar Aircraft Company, San Diego 12, California.

SOLAR AIRCRAFT COMPANY
SAN DIEGO
DES MOINES

Designers, Developers and Manufacturers • Gas Turbines • Aircraft and Missile Components • Bellows • Controls • Coatings • Metal Alloy Products

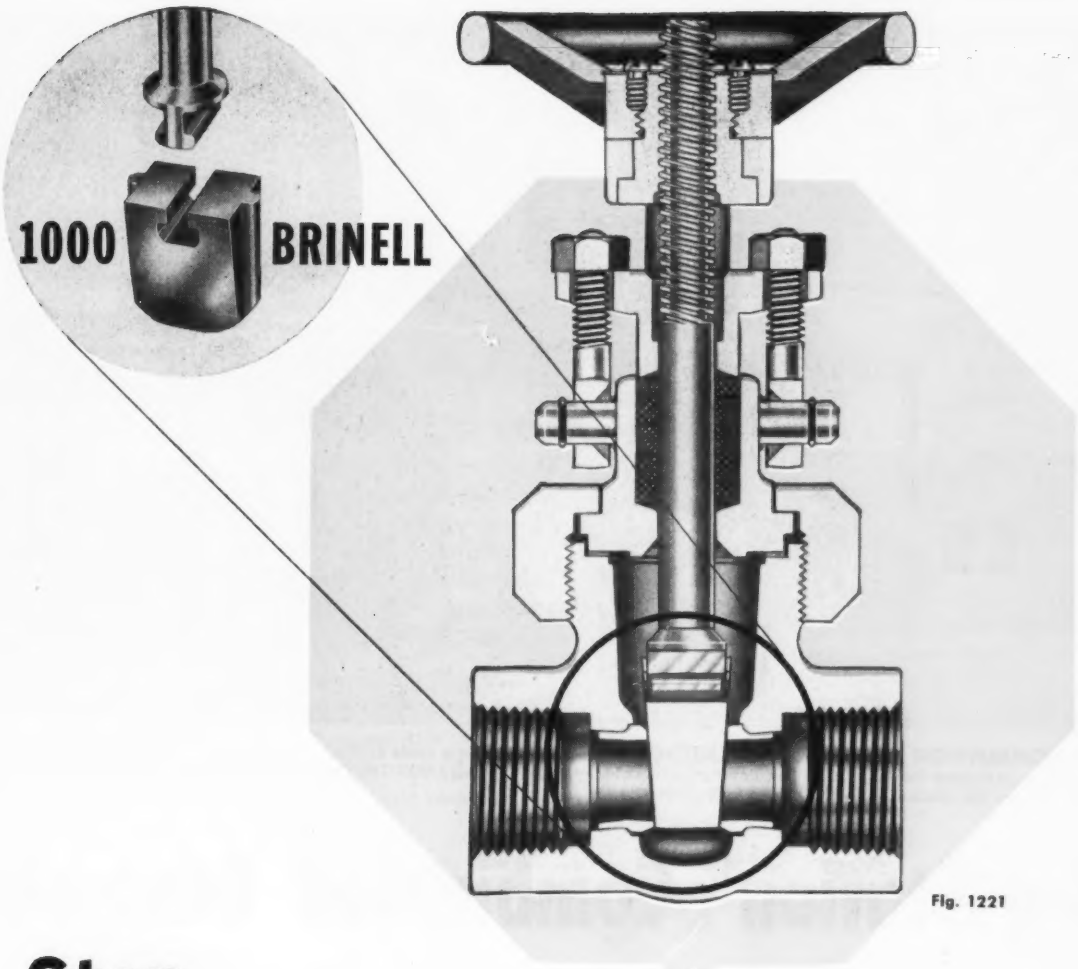


Fig. 1221

Stop Galling with the hardest valve wedges you can buy

Highly resistant to erosion and corrosion

Here's a wedge as hard as flint . . . so hard that it's undamaged by pipe cuttings, scale or grit. It's the only trim we know of which will successfully withstand the simultaneous attack of the three valve-destroying agents—corrosion, erosion, galling. This wedge is *13% chrome stainless steel hardened up to 1000 Brinell.*

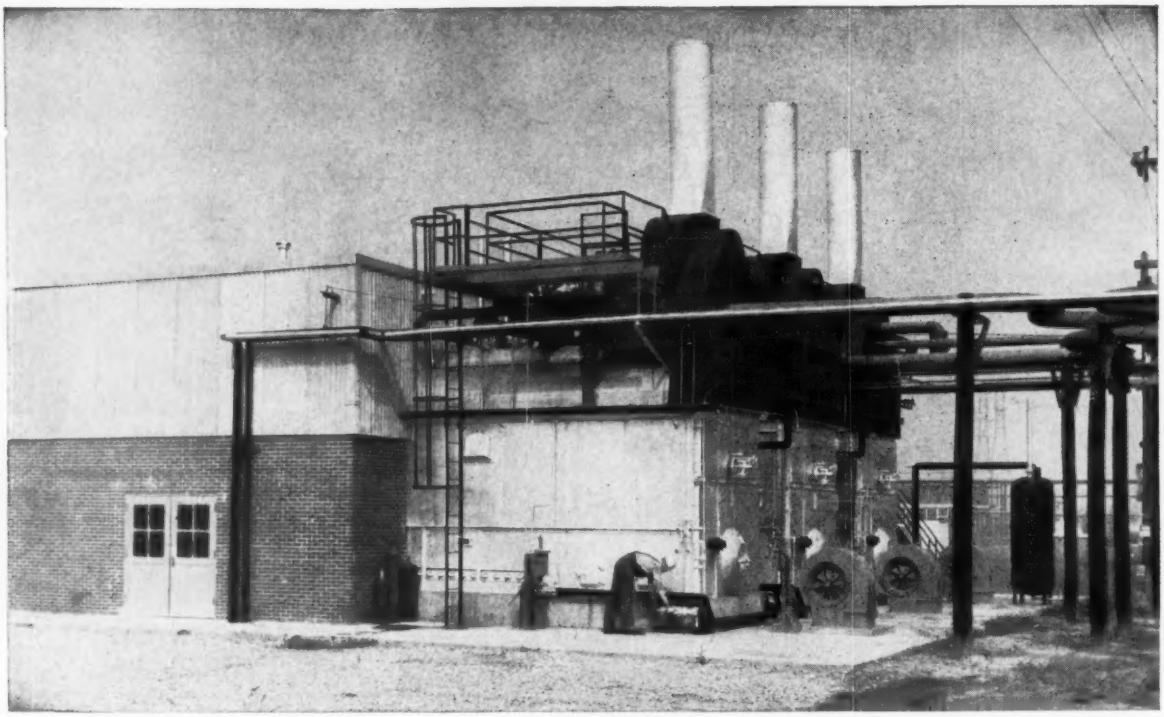
Specify the OIC 1221 gate or 1621 globe where you need the extra rugged nature of forged steel. They are recommended for steam service up to 800°F...oil service up to 1000°F. Or, use these same valves for hydraulic service up to 2000 lbs.

Write for Form 195 for specifications on the OIC forged steel line.

OIC VALVES

FORGED & CAST STEEL, LUBRICATED PLUG, BRONZE & IRON VALVES

THE OHIO INJECTOR COMPANY
WADSWORTH, OHIO



COMBUSTION CONTROLS GO OUTDOORS to help cut steam costs at American Synthetic Rubber Corporation's new packaged boiler plant near Louisville, Kentucky. The three 27,000 lbs./hr. gas or oil fired boilers operating at 175 psi generate steam for heating and processing.

"Big Station" Combustion Controls

Metering-Type Republic Control System Saves Fuel, Enables Boilers to Handle Fast Load Changes Quickly and Smoothly at American Synthetic Rubber Corporation

Peak combustion efficiency plus fast control of widely varying loads—these were combustion control requirements at American Synthetic Rubber Corporation's new packaged boiler plant near Louisville, Kentucky. To meet them, a metering-type combustion control system was specified instead of the "off-on" system usually furnished with packaged boilers. This system contains all of the basic control elements found in large installations and has all of the operating refinements common to large plants.

Is this metering-type control system worth its premium price? Flue gas tests made at various ratings conclusively answer the question with an emphatic YES. Combustion efficiency exceeds what similar packaged installations are delivering — and smoother operation is preventing chain-of-event troubles that frequently are caused by improper boiler operation. American Synthetic expects the controls to pay their extra cost in just a few years through fuel savings alone.

REPUBLIC FLOW METERS CO.

HOW METERING SYSTEM AT AMERICAN SYNTHETIC SAVES FUEL

Unlike most packaged boiler control systems, the Republic Combustion Control System at American Synthetic continuously measures both fuel and air inputs. Changes in fuel pressure, for example, which change the rate of fuel feed are detected immediately and automatically compensated for. Proper fuel-air ratio is maintained automatically at all ratings for maximum combustion efficiency.

Fast load changes are common in the plant with fluctuations varying as much as 8,000 lbs./hr. Rapid control response with Republic's dash-pot stabilization which prevents "hunting" enables boilers to meet new steam demands quickly and smoothly. Steam pressure and draft are held constant even during changing loads by the controls.

CONTROL SYSTEM CHANGES WITH FUEL

On oil firing, the controls operate on a steam flow-air correction system. For safety on gas firing, the controls are transferred to an air flow-gas flow correction arrangement which prevents over-firing in case air to the boilers is limited or blocked for any reason.

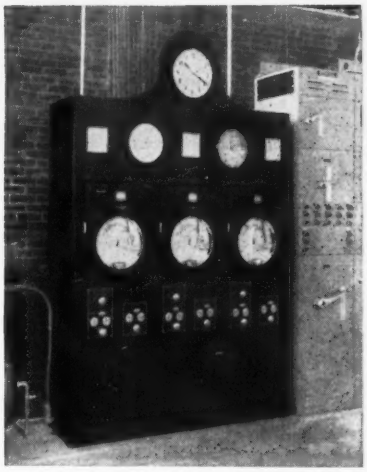
OPERATORS ARE ENTHUSIASTIC

The automatic correction feature of the Republic Controls eliminates time-consuming gas analysis and adjustments which would be necessary periodically with other types of controls. Correct operation of the boilers is easier, surer.

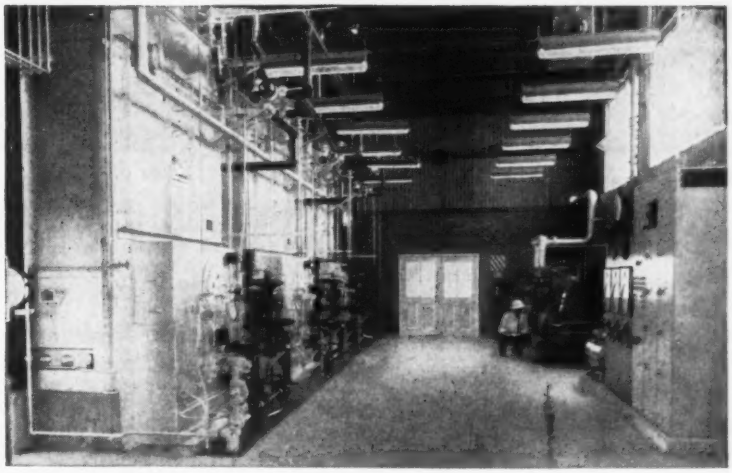
IF YOU ARE PLANNING ON INSTALLING PACKAGED BOILERS, find out how metering-type combustion control by Republic can improve efficiency, cut fuel costs and make operation simpler and easier. Contact your nearest Republic representative.

IF YOU ARE PLANNING *ANY* BOILER PLANT—any size, type or method of fuel firing — you can be sure of maximum efficiency with a Republic Combustion Control System engineered to exactly meet your needs. Write us when your problem is combustion control.

Pay Off for Packaged Boiler Plant

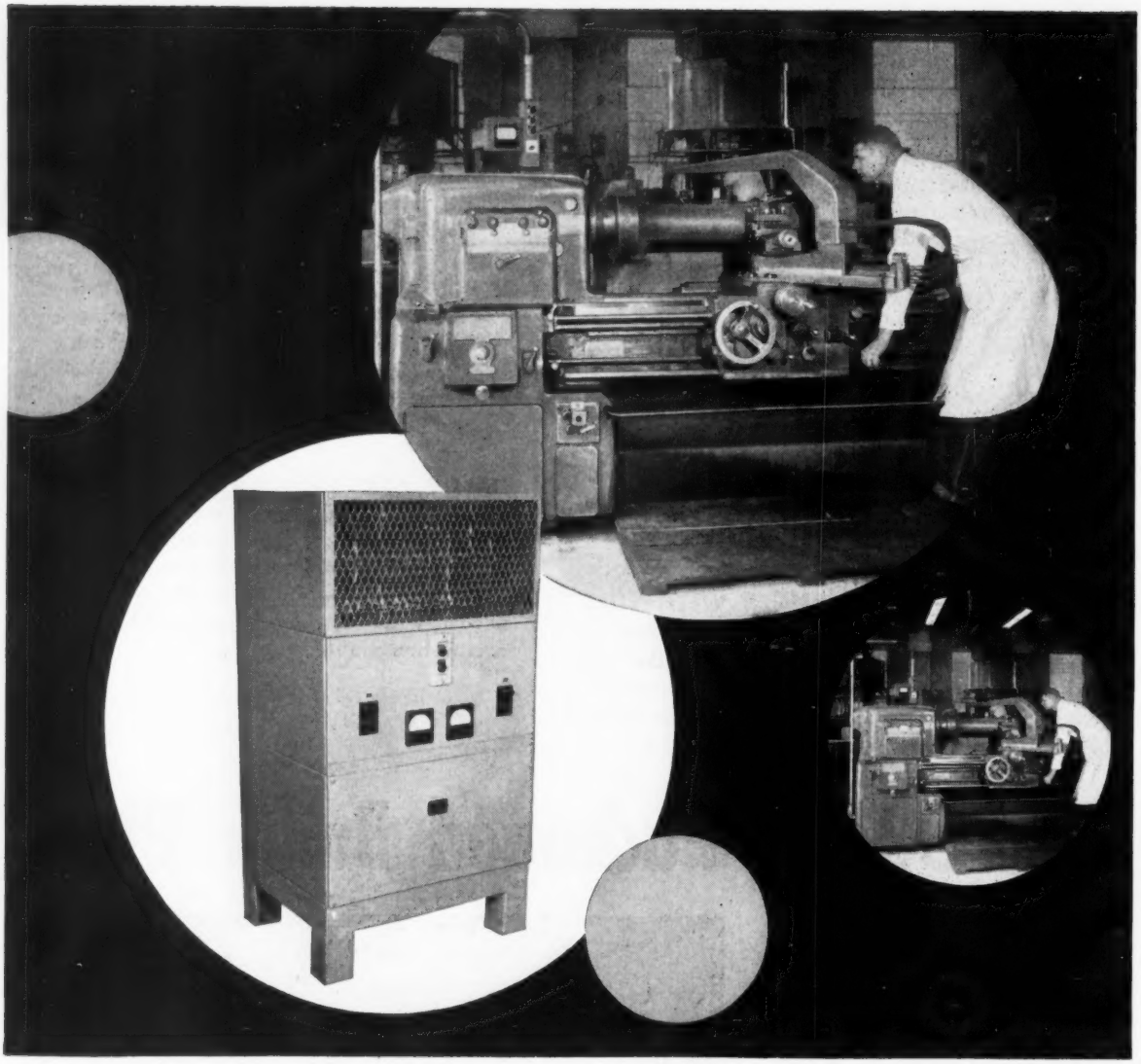


CENTRALIZED instrument and combustion controls on this Republic panel make checking and manual operation convenient and easy.



LOOKS EFFICIENT . . . AND IS. Interior view of the boilerhouse. All three boilers can be operated together or separately by means of control panel at right.

2240 Diversey Parkway • Chicago 47, Illinois



Dependable D-C ON THE SPOT...economically

Here is the low-cost, low-maintenance way to have d-c power exactly where it's needed—and it's more efficient than any other type of power conversion unit.

D-c power conversion units are available in ratings of ⅛ to 2 kw single-phase input and 1 to 100 kw three-phase input—ratings to meet your power requirements. And these units rely on long-lasting Rectox® selenium stacks which show less than 5% increase in forward drop after more than 16,000 hours of continuous life testing.

Westinghouse also furnishes a complete line of silicon units. For further information—call your Westinghouse sales engineer. Or, write Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pennsylvania.

J-22032

YOU CAN BE SURE...IF IT'S Westinghouse

LOUIS N ROWLEY, EDITOR • APRIL 1957 • ESTABLISHED 1882 Power

The future: How do you see it?

MOST OF US in the power field live in the future a good part of the time. Not as idle dreamers seeking escape, but because the future is our business. No matter how urgent today's problems seem, we must always be looking ahead—planning the improvements that will avoid problems in the coming years and the expansion that will meet tomorrow's rising demands.

It is thus only natural that the future will be a dominant theme in the special September issue that will mark completion of POWER's 75th year and the beginning of a new era of even greater editorial service to the advancing power field. In that issue we plan to enlist the best thinking in the field to help us chart the path of power-service development.

Since the future grows out of the present, we will start by probing each power-field area to evaluate today's present practices and trends. This extensive, and intensive, survey will then serve as a basis for appraising the developments to be expected in the years ahead.

We plan to present the results to you in a group of special reports under the general title "The Power Field Today and Tomorrow." Together, these reports will form one of three main sections into which the big September issue will be divided.

The first of these reports will deal with trends in planning and design of power-service systems: generating plants, steam and electrical distribution, compressed-air, water-supply, refrigeration and air-conditioning systems.

Then will come a series of six reports, each dealing with one broad group of power-service equipment for: steam generation, mechanical power, electrical distribution, fluid handling, heat exchange, instrumentation and control.

Final report of the group will deal with a subject of prime importance to all of us—managing tomorrow's plants. Here we'll discuss the methods and procedures that will be needed to keep tomorrow's equipment lubricated, maintained and running efficiently. We'll seek answers to such questions as the effect of the ever-rising cost of manpower and the problems of selecting, training and organizing the ever more highly skilled personnel that will be needed for more precise and complex operations.

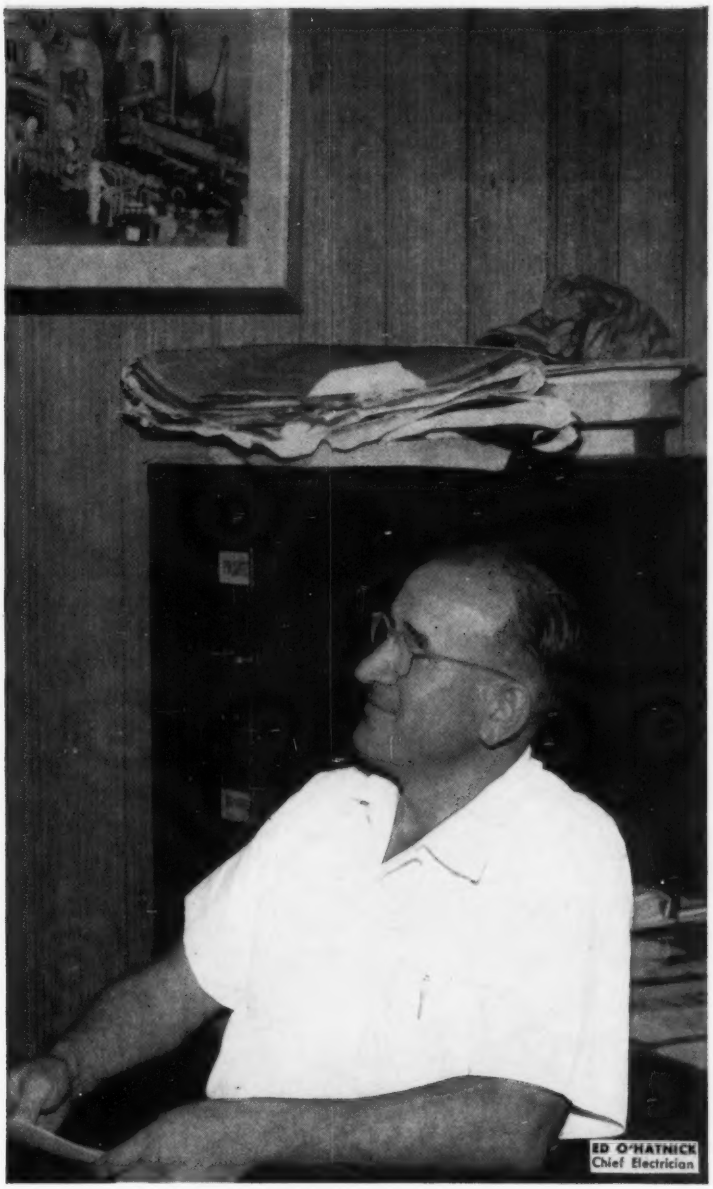
In all of these areas we are now assembling our own facts and thoughts. We have begun to collect, by interview and correspondence, the thinking of leading consultants, equipment manufacturers and plant designers. And we would like to invite all readers of POWER to join us in this major effort to outline the shape of things to come for power-service men.

Specifically, we would welcome your thoughts on managing tomorrow's power services—an area of deep concern to most POWER readers. We hope you'll take time out from today's tasks to look ahead a bit, to drop us a note about what you are doing management-wise in planning for the future. We believe this will be useful to you, helpful to us.

"By installing Fusetron Fuses . . .

We saved from $165 to $225 worth of solenoid coils a year and reduced down-periods"

ED. O'HATNICK, CHIEF ELECTRICIAN
FRANK KNEELAND PLANT, UNITED ENGINEERING & FOUNDRY CO.
PITTSBURGH, PA.



Mr. O'Hatnick continues . . . "The solenoids on the hydraulic clutches of our horizontal boring mills would sometimes stick or slow down when dirt got into the oil.

"When this happened, the tap D. C. solenoid coils wouldn't be pulled in far enough so they would burn up.

"Each coil cost about $15 and with 12 to 18 of them burning up every year it didn't take long for this to add to a considerable amount of money.

"And even more costly were the production losses that resulted from these shutdowns.

"With hope of reducing these expenses, we decided to individually protect the 72 solenoids in use with 3/10 ampere Fusetron dual-element fuses.

"In the next 3 years only 2 coils burned up.

"We had other favorable experiences with Fusetron fuses that convinced me they can make a plant more effective.

"That's why, upon being transferred to our Frank Kneeland Plant, I made a study to see where Fusetron fuses can be applied to help us reduce operating costs."

357

Here's why Fusetron dual-element Fuses protect solenoids, coils and transformers against burnout.

By installing the proper size Fusetron dual-element fuse, a solenoid can be protected. The Fusetron fuse will not open on the operating surge but will open in time to protect, should the heavy current continue too long for any reason.

A transformer or coil, likewise, can be protected because the long time-lag of the Fusetron fuse permits it to hold all normal current surges and harmless overloads—yet it will open to prevent burnout on any dangerous overload.

All you need to protect Coils, Transformers or Solenoids against burnout is a Fusetron fuse plus a fuse block or a BUSS fuse holder.

On voltages up to 125 the same dependable protection can be provided with a proper size Fusetron plug fuse or BUSS Fustat.

FUSETRON FUSES DO MORE THAN PROTECT SOLENOIDS AGAINST BURNOUT . . . ***They Provide 10 Point Protection*** **1.** High interrupting capacity—protect against heaviest short circuits. Have proven on tests to open safely on circuits set to deliver in excess of 100,000 amperes. **2.** Protect against needless blows caused by excessive heating — lesser resistance results in cooler operation. **3.** Protect against needless blows caused by harmless overloads. **4.** Provide thermal protection — for panels and switches against damage from heating due to poor contact. **5.** Protect against waste of space and money — permit use of proper size switches and panels. **6.** Protect motors against burnout from overloads. **7.** Give DOUBLE burnout protection to large motors — without extra cost. **8.** Protect motors against burnout due to single phasing. **9.** Make protection of small motors simple and inexpensive. **10.** Protect coils, transformers and solenoids against burnout.

Write for bulletin FIS.

FOR LOADS ABOVE 600 AND UP TO 5,000 AMPS . . . USE BUSS HI-CAP FUSES! When coordinated with Fusetron fuses they will not open ahead of the fuse nearest fault.

Write for bulletin HCS.

Play Safe! *install FUSETRON dual-element Fuses and BUSS Hi-Cap Fuses throughout entire Electrical System!*

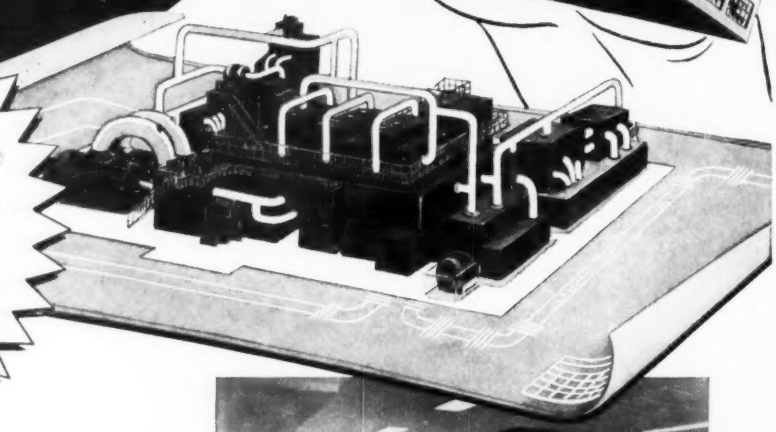
FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

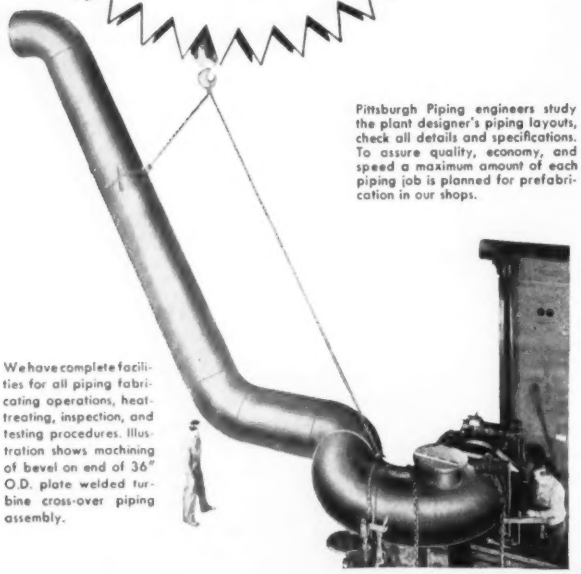
BUSSMANN MFG. CO. *Div. of McGraw-Edison Co.*
University at Jefferson, St. Louis 7, Mo.

ENGINEERING at Pittsburgh Piping

another P. P. & E. service which contributes to Improved

HIGH-TEMPERATURE HIGH-PRESSURE PIPING





We have complete facilities for all piping fabricating operations, heat-treating, inspection, and testing procedures. Illustration shows machining of bevel on end of 36" O.D. plate welded turbine cross-over piping assembly.

Pittsburgh Piping engineers study the plant designer's piping layouts, check all details and specifications. To assure quality, economy, and speed a maximum amount of each piping job is planned for prefabrication in our shops.

We assume responsibility for every phase of a piping job — from blueprint through erection. Our engineers are specialists — thoroughly experienced in the theoretical and practical aspects, as well as in the code and insurance requirements, of high-temperature, high-pressure piping.

PRODUCTS AND SERVICES

Carbon Steel Piping	Forged Piping Materials
Cast Iron Fittings	Headers
Cast Steel Fittings	Manifolds
Chrome-Moly Piping	Pipe Bends
Copper Piping	Stainless Steel Piping
Corrugated Piping	Van Stoning
Creased Bends	Welded Assemblies
Expansion Bends	Welded Stainless Steel Tubing
Flanges	Welding Fittings

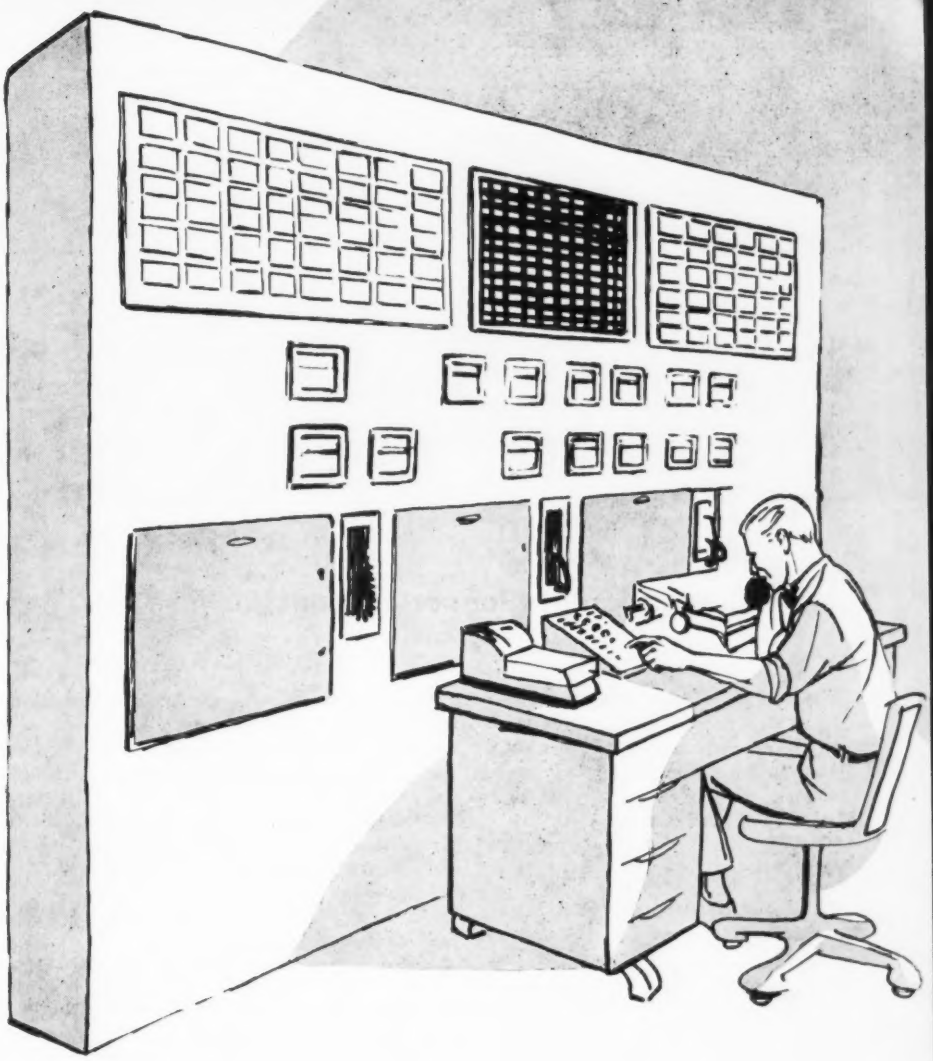
PP-21

Pittsburgh Piping AND EQUIPMENT COMPANY
158 49th Street — Pittsburgh, Penna.
CANADA: CANADIAN PITTSBURGH PIPING, LTD.
835 BEACH ROAD—HAMILTON, ONTARIO

OFFICES IN PRINCIPAL CITIES

Atlanta	Whitehead Building
Boston	10 High Street
Chicago	Peoples Gas Building
Cleveland	Public Square Building
Hollywood	1828 North Alexandria Ave.
New Orleans	P. O. Box 74
New York	Woolworth Building
Syracuse	113 So. Salina Street
Toronto	68 Yonge Street

B G A SKROTZKI
Associate Editor in Charge



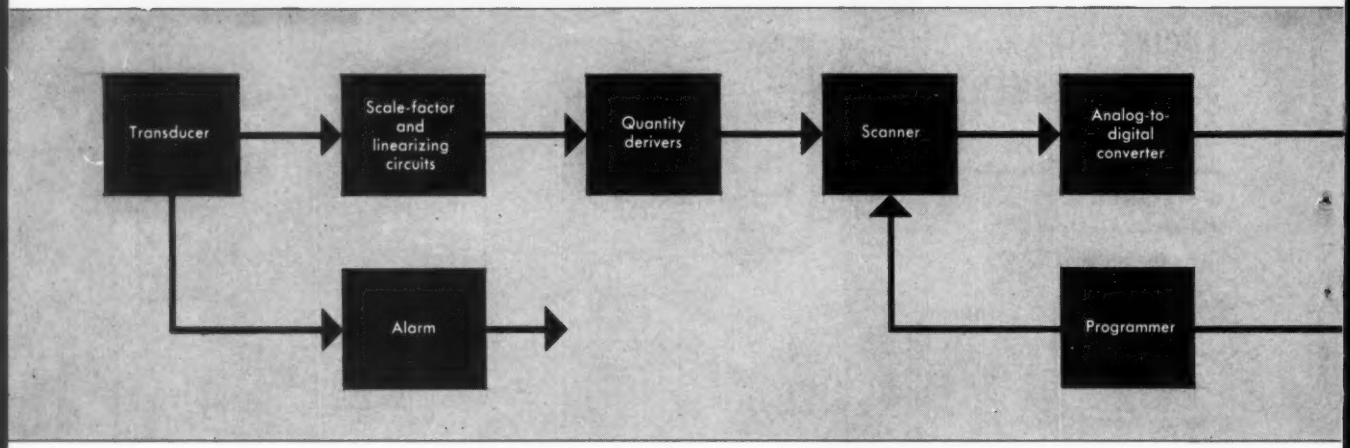
Automatic data logging—a step closer to the automatic plant

► THE PRACTICE of keeping plant operating logs dates back more years than we'd care to count. Power men base important decisions on the information contained in them. Yet, manually logged data has several important drawbacks. Hand logging of a hundred or more variables is time consuming. But even more important, it's subject to human error.

Now, enter automatic data logging. You get an automatically typewritten record in seconds. Off-normal data command immediate attention by audible and/or visual signals and automatic logging of off-normal conditions in red type. The human element is largely eliminated.

We don't mean to imply that automatic logging is a cure-all. But the technique promises to carve an important place for itself in the power field. In this report we'll see how the equipment works, what the first U.S. power installation looks like, how experts view its future. **Turn page**

By **HOWARD P KALLEN**, *Associate Editor*



Automatic data loggers fit together like this. Refinements depend on

The simplified block diagram, above, traces flow from the input signal into the transducer to the automatically printed log sheet, punched tape, punched card or other record form. Let's follow system flow to see . . .

How it works

Some systems use all of the components shown. Others, because of their application, can eliminate one or more of the elements. Ultimate goal of control engineers is to have the recorder feed data back directly to the control system to apply corrective effort. But, from a practical viewpoint, such refinements must be balanced against cost to achieve a sound, economical system.

Start with the transducer: It measures pressure, temperature, flow, etc., delivers an electrical signal. Temperature transducers allow heat to act on an expanding-contracting fluid, thermocouple, variable resistor, pyrometer. Where temperature is converted to a pressure signal (expanding-contracting fluid), secondary transducer converts pressure to an electrical signal. Thermocouples may be used to get electrical signal directly. Pressure transducers may use a bellows to drive a potentiometer or movable-core transformer. Flow transducers may be electrical flowmeters. Or they may convert differential pressure to an electrical signal or air signal; and then, via a transducer, to an electrical signal.

Scale-factor adjustment of transducer's output is necessary because the analog-to-digital converter works best in a particular voltage input range. In its best range, the converter is sensitive to small input voltage differences. Basically, scale factor adjustment is a change in voltage scale from the transducer output to the range required for converter input.

Linearizing operation takes nonlinear relation between transducer input and output, converts it to a linear (straight-line) relation. Some transducers have an inherently linear relation (pressure transducers for instance). Thus they don't need linearizing circuitry. Flow transducers based on differential pressure measurement need linearizing components because pressure drop is proportional to the *square* of velocity.

Data derivation. Not always do we measure the variables that we will finally log. Often the data we want isn't directly measurable. But it may be related to an easily measured quantity by solving an equation. The quantity deriver in this case is designed to solve the equation. Square-root extractors do essentially this when they relate differential pressure to flow velocity. Sometimes we may want to log the sum of a variable over a specified time. The deriver is then an integrating electrical circuit or a mechanical integrator.

Scanning equipment makes it possible for a single automatic logger to "look at" many transducers in a specified sequence. Scanners may be motor-driven commutators, solenoid-operated stepper switches or electronic commutators. They are, in effect, traffic directors that channel data from system input to the correct column in the automatic typewriter or other recording device.

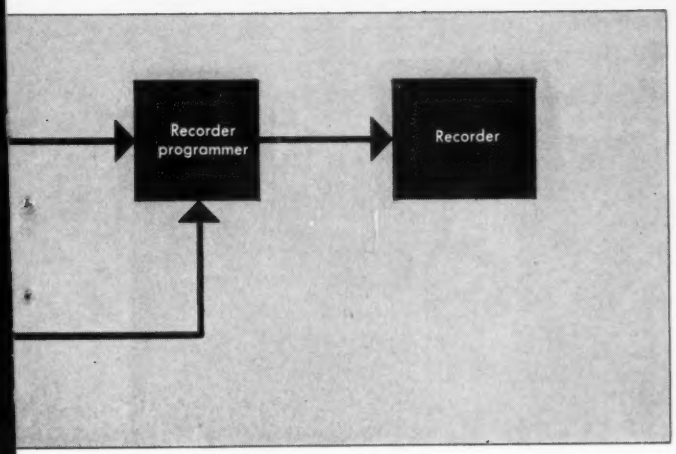
Analog-to-digital converters. Signals that come from transducers via scanners are the electrical *analogy* of measured quantities. These must be converted to digital form before they can be recorded. Converter outputs are in coded form. Pulse codes, such as the telegraphers', are a common type of digital code. Converter equipment is largely electromechanical.

Programming keeps entire logging system moving through its paces according to a specified sequence: timing controls initiate commands; programmer sets scanners, recorders; scanner unit scans and selects transducer circuits in sequence; programmer energizes analog-to-digital converter. After data is logged, programmer resets converter, signals scanner to move on to the next log point.

Alarm systems generally operate independently of the logging system. They can be set to indicate dangerous conditions or off-normal conditions that are not dangerous but should be corrected to achieve most economical operation. Off-normal data may be recorded on the log sheet in a second color (usually red) or it may feed into a separate off-normal printer.

Alarm systems may be either scanning or nonscanning types. Nonscanned designs are simpler, less likely to develop trouble. Choice often boils down to individual preference.

Logging method depends on purpose of the data. Log sheets are prepared on an automatic typewriter. Power applications, at present, fall into this class. Data presentation may also be visual (on cathode-ray tubes for instance), or set up to feed a computer. Punched tape, punched cards or one of several memory-storage devices (magnetic drum for example) serve this purpose.



how much you can justify spending

Terms that may be new to you . . .

Analog-to-digital converter — Analog signals (voltages, currents or mechanical displacements) that are proportional to plant temperatures, pressures, flows, etc, must be converted to digital form before they can be recorded as a printed number. The converter, an electrical instrument, receives the analog signal, delivers an output signal that can actuate the automatic typewriter.

Automatic logging — The automatic and periodic recording of data in printed form.

Automatic typewriter — An electrically operated unit to log data on printed forms according to a preset schedule.

Memory storage — A device into which information can be fed, stored and extracted at a later time.

On-demand read out — A printed record of any data called for by the operator at other than regularly scheduled times.

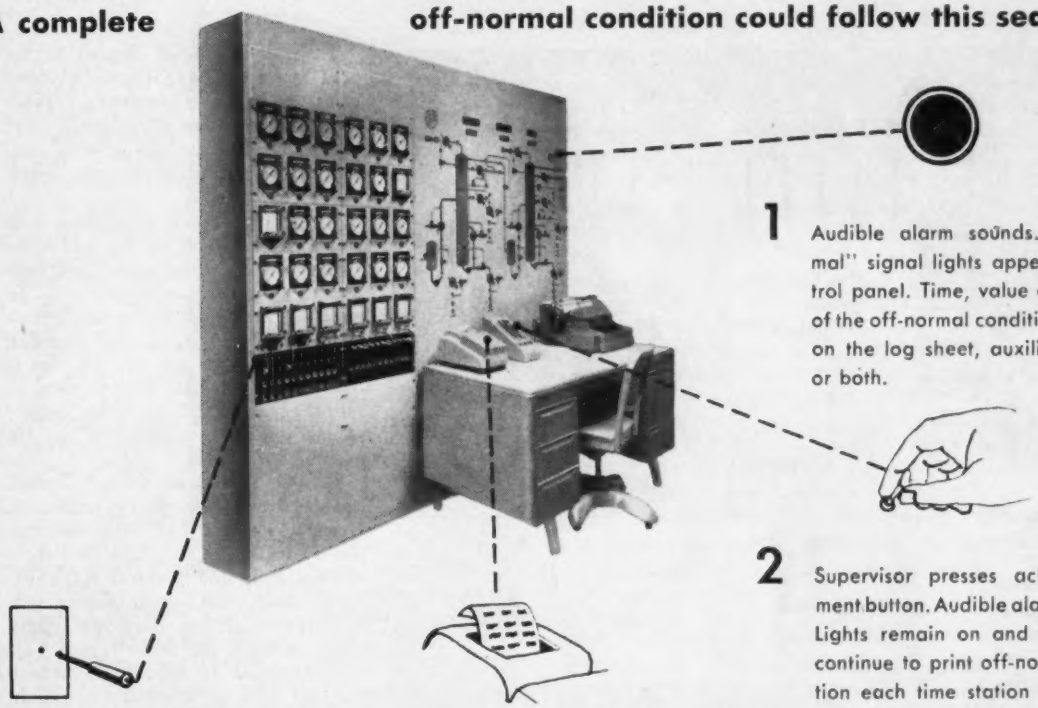
Programmer — A device into which a set of instructions, arranged in sequence, can be fed. The programmer then issues proper commands to tell the system what to do and when to do it.

Scale-factor correction, linearizing — Operations performed on transducer output signals. Scale-factor correction changes output voltage range of the transducer to the best voltage input range for the analog-to-digital converter. Factor correction assumes a linear relation between the measured variable and the voltage representing it. If the linear relation doesn't exist, then the transducer output must be linearized.

Scanning — Automatically and continuously monitoring variables.

Transducer — A device for converting measured physical data to an electrical signal.

A complete off-normal condition could follow this sequence:



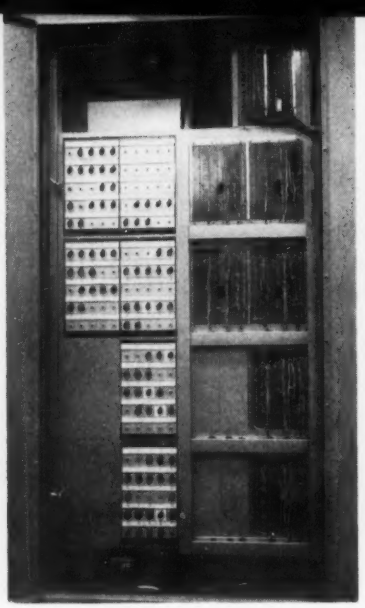
1 Audible alarm sounds. "Off-normal" signal lights appear on control panel. Time, value and station of the off-normal condition appears on the log sheet, auxiliary printer or both.

2 Supervisor presses acknowledgement button. Audible alarm silences. Lights remain on and printer can continue to print off-normal condition each time station is scanned.

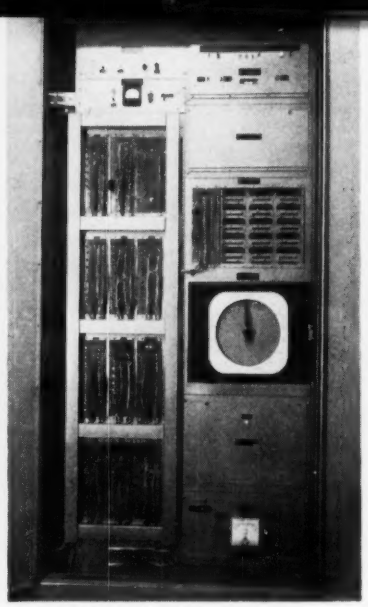
3 Signal lights draw attention of supervisor to instrument or jack plug associated with the off-normal data. Recorder station is plugged in to record trend. Corrective adjustments made if needed.

4 On return to normal, signal lights go out. Printer can be set to print confirmation of return to normal condition. During regular logging, off-normals are shown on typewriter as well as auxiliary printer.

INFO CENTER at Neches Plant includes alarms, scanners, recorders and loggers

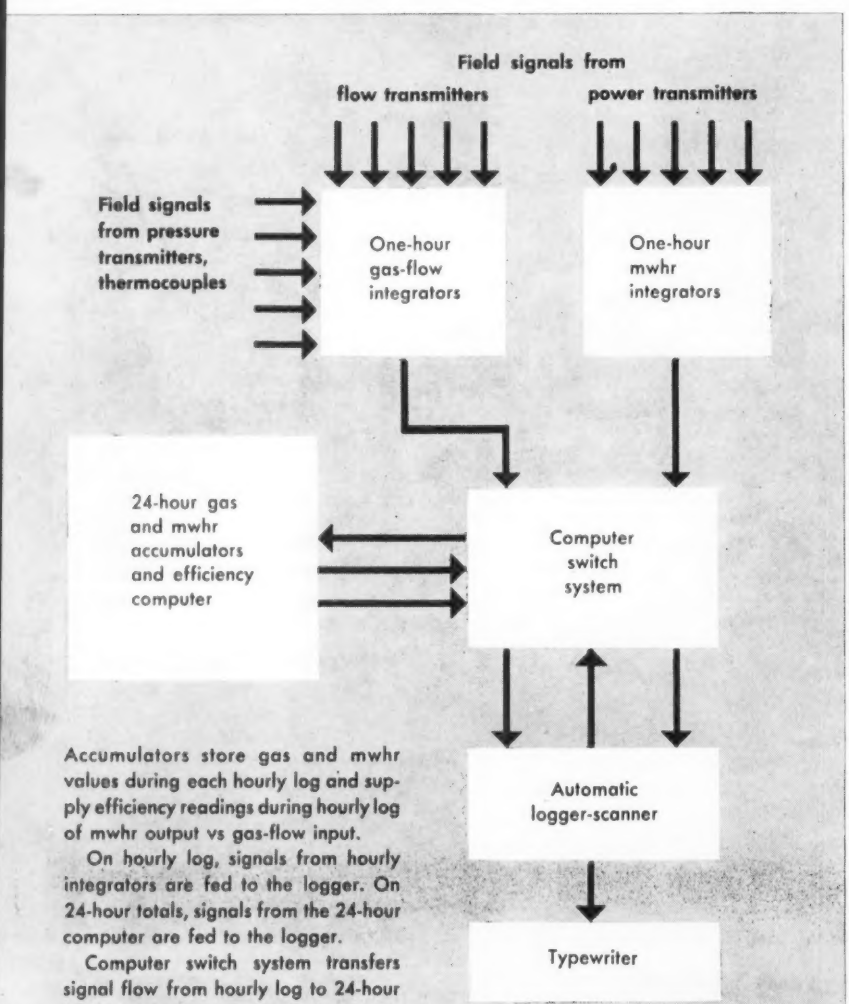


MEMORY SYSTEM of info center, *right*. Off-normal adjustable set points, *left*



PROGRAMMER detectors, digital storage, power supply, analog-digital converter

*First U.S. central-station user sizes up automatic data logging,



Accumulators store gas and mwhr values during each hourly log and supply efficiency readings during hourly log of mwhr output vs gas-flow input.

On hourly log, signals from hourly integrators are fed to the logger. On 24-hour totals, signals from the 24-hour computer are fed to the logger.

Computer switch system transfers signal flow from hourly log to 24-hour totals.

The Neches Power Station of the Gulf States Utilities Company at Beaumont, Texas, has a generating capability of 274 mw from six generators and 111 mw from their new seventh unit. The eighth unit, another 111 mw, is now under construction.

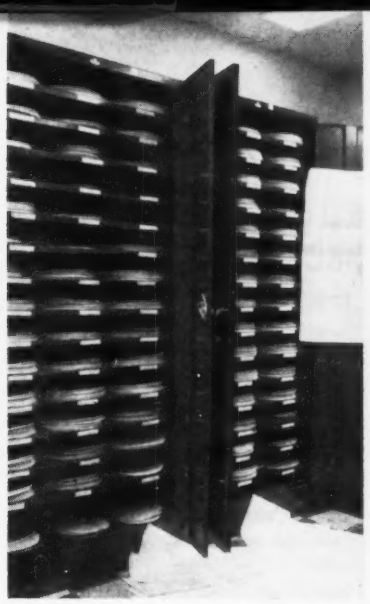
With many modern units being built on the system, older stations had to be modernized and experienced men were needed to operate the new stations. To meet this need, Gulf States installed an automatic data logging and scanning system (supplied by Panellit, Inc.). *Result:* Enough men were released to run the new units. And the logger-scanner system is expected to pay for itself in three years.

Why an information center? Neches engineers reap these benefits from their system (they refer to it as an information center): (1) It brings all important operating info to one central point for alarming, recording or logging. (2) It eliminates all log sheets and charts except those in the control room. (3) It is expected to improve individual unit and total plant efficiency. (4) It relieves trained men to operate many new units being installed. (5) It supplements, without replacing, present instrumentation. (6) It reduces operating costs of old generating units.

A look at the info center. Photo, top left, shows the information center.

---

*Abstracted from ASME paper No. 56-A-219. *The information center with automatic logger and scanner*, by J A Reich and W B Gurney, Gulf States Utilities Co, Beaumont, Texas.



LOG, *upper right,* compared to past log sheets and charts, points up time saved

AUTOMATIC TYPEWRITER with log sheet in position, along with convenient telephone connected to scattered plant areas, provides efficient plant nerve center

sees manpower savings, better efficiencies, new instrument concepts

At top center of panelboard (under the clock) is the bearing-temperature-scanner panel, covering 109 high-speed sleeve bearings. These include bearings on the generator, exciter, turbine thrust, boiler-feed pumps, f-d and i-d fans. Upper left on panel is the 40-point local panel alarm of retransmitted alarms from 21 panels located in the plant. If any of these alarms sound, the info center operator dispatches a roving operator to the panel. These 21 panels cover more than 180 functions of level, temperature, etc.

The upper-right panel covers 28 individual alarms, which are either very important or not covered by the local panel alarm.

The bearing scanner is entirely separate from the logger and its scanner. Regular scanning is once every 15 minutes, or faster if necessary.

Below the alarms are 14 two-pen trend recorders. Top row records the output in net kw and the input in gas Btu for total plant and for each boiler-turbine unit. Lower row records gas cfm, feedwater flow and superheat temperature. Two of the trend recorders can be jacked into various log points from the patch panels located below trend recorders.

Left-hand patch panel contains any log point other than temperature and those points already trend recorded. Middle patch panel contains only temperatures that can also be logged on the typewriter. Right-hand patch panel contains bearing temperatures only.

Key feature of the system: All alarms, trend recorders and jacks operate independently of, or parallel with, the logger and its typewriter.

The typewriter automatically logs 111 points hourly or on demand. The entire cycle takes three minutes. Scanning goes on continuously when equipment isn't logging.

The log sheet records off-normal points in red in a special part of the sheet, showing the time, point number and value. The sheet reprints these in red during periodic log. On returning to normal, the red figures become black in both log and off-normal sections.

Photo, top left, compares the single automatic log sheet with past log sheets and recorder charts. The automatic logging sheet includes hourly net kwhr output, Btu input, heat rate in Btu per net kwhr for each boiler-turbine unit and for the total plant. Including alarms, bearings, trend recorders and log, over 450 points are monitored at the information center.

Before Neches installed its info center, it needed 54 operators to handle six units generating 264 mw. Now 41 operators do the same job with a big assist from automatic logging. Thirteen men are relieved to operate the two new 111-mw units.

Block diagram, facing page, shows how signals feed into the information system. Btu and mwhr signals from field-mounted transmitters flow continuously to the one-hour integrators. If an operator presses the on-demand button before the regular hourly automatic log, each Btu and mwhr value accumulated during the last hour is printed out. At the same time each Btu and mwhr signal is sent to the Btu and mwhr accumulators and stored.

During the hourly log, efficiencies are printed out for each Btu and mwhr point by automatically computing the ratio of Btu to kwhr. The 24-hr totals are printed in the log sheet's totals section. After the completion of print out on all totals, both Btu and mwhr accumulators are reset to zero and are ready for a new 24-hr accumulation.

Summary of the entire logger cycle: (1) signal input (2) data point selection (3) system balance (4) data storage (5) print out.

How Neches engineers feel about their novel information center can be summed up like this: The entire system has bettered its expected accuracy in pressures and temperatures. Kw and gas Btu accuracy are well within expected results. And by reducing manpower, boosting efficiency, the system is trimming operating expenses.

General philosophy regarding the type of instrumentation required with an automatic information-gathering system is gradually being altered in the minds of Neches engineers. In future installations they will probably dispense with some of the more conventional instruments and depend more on their automatic logging-scanning.

Cost of this pioneering installation was about $150,000.

How experts view the role of data logging in power plants

POWER put the following five questions to leading authorities in the power-controls field. Here's the gist of their thinking on where automatic data loggers stand today, what they hold for the power services.

What advantages, limitations do you see for automatic data logging in power plants?

"One of the prime reasons for the desirability of automatic scannng and data logging is the conservation of space in control centers. Space is valuable not only because of the cost of providing it, but also because an operator can't devote full attention to an unlimited panel area."

"One advantage is timeliness of information. Data is currently available for operators, engineers and management to make decisions as they are needed. Also, all power system upsets are automatically logged, eliminating the human tendency to hide errors. We call it the "second reading" complex that often provides uniform records even when the plant hasn't actually operated on this basis. . . . Information points can be selected so that plant or unit heat rates can be checked frequently to assure efficient operation. . . . The current limitation on information systems lies not in the system but in the way it's applied. As with any of the new digital technologies, full value of the data system depends on continued and intelligent use of the information made available."

"Automatic scanning and data logging will reduce manpower, eliminate human error and log at precisely the right time. High-speed scanning will quickly catch off-normal readings."

"Possible limitation of present systems is their cost."

"The accuracy of recorded data will be much improved over manually logged information. But reliability of this type of instrumentation must be extremely high so that instrument downtime is at a minimum. Also, systems must be engineered to provide maximum accessibility in case components need to be replaced."

What are shortcomings of conventional data recorders that make automatic data logging desirable?

"Present data-recording techniques are generally based on the use of line-drawing instruments. To get numerical values from these records requires reading by *human* operators. The process is dull and uninteresting for the operator. And, at today's manpower costs, it is expensive. . . . As plants become larger and as instruments are added to keep track of the many spread-out points in the plant, the human operator becomes a bottleneck in plant operation. Why? The operator can receive only a limited amount of info in any time interval."

"It is difficult to include all measurements which should be logged, on conventional multipoint recorders."

"Filing of chart records made by continuous recording devices can be a big drawback of conventional systems. These are usually daily round charts or tear-off strip charts. Space for storing these records can be vastly reduced and the ease of future access to this information facilitated by automatic data loggers."

"Where data must be used by an accounting department, conventional chart interpretation is difficult."

Do you picture automatic data logging as an addition to, or substitute for, conventional methods?

"We consider data logging both as a substitute for certain conventional recording methods *and* as an addition to others."

"At the present time we must view automatic data logging and scanning as an adjunct to conventional recording instruments. We feel that in time these systems will replace conventional instruments in many applications. Where control is involved, the shift will be to indicating, rather than recording controllers."

"We believe that automatic logging and scanning will not entirely replace other types of recording. Many power-plant measurements are taken mainly to establish records and permit efficient system bookkeeping. These measurements are probably most suitable for automatic logging. . . . Many other measurements are taken to insure that various quantities remain within safe limits. These, at present, are handled by annunciator alarm systems. But they can be handled quite efficiently with automatic data loggers. . . . Still other measurements are important to the operator not only for their instantaneous value but also for their rates of change and their history over the previous one to ten minutes. For these applications we see a continuance of present trend-recording units or refinements of them."

Are the requirements of data loggers for power applications more severe than for process?

"We believe that in some cases, engineering requirements of power-plant data loggers are more stringent than for process. But, sometimes the reverse may even be true. Basic problem in power work, not present in process: There is no practical way of storing the output of a power plant—electric energy. In process plants, product storage is generally easy and economical. Thus continuous operation (and high reliability) is more essential for the power plant."

"In the power plant, three factors—vibration, electrical noise and dust—present engineering problems not often found in process plants. The power-plant logger must, therefore, be designed to withstand these conditions."

"We are presently designing all our loggers, regardless of application, to be as reliable as possible. As to economic requirements, we have felt right from the start that the purchase of loggers by power plants can readily be justified."

What factors may tend to slow down or speed-up wide use of automatic loggers in the power field?

"First cost, lack of trained manpower and misapplication may slow down their wide use."

"These systems have only begun to find their way into power plants. They still have to establish an operational record. Once such history is available, potential users will be in a better position to evaluate loggers."

"Lack of standardization of control signal magnitudes may cause engineers to take a wait-and-see attitude."

*Bailey Meter's P S Dickey takes a look ahead...

sees future power instrumentation falling into three groups

We believe that instrumentation for the future steam-electric generating station will be split into three groups, diagram at right.

First group includes instrumentation necessary for guiding the operation. It will be designed for maximum reliability and minimum outage, and will actuate the automatic control system. It includes the necessary indicating and recording devices to guide the operator during normal, startup and emergency operation. It is a somewhat simplified version of instrumentation used in today's control center.

Second group, data-gathering and analog-type processing equipment is for precise performance determination. The instrumentation will be of the highest possible precision and applied in such a manner that it may easily be removed from service for calibration checks to insure that high precision is maintained.

Third group of instruments will transmit to scanning devices which may be designed to accomplish any desired objective from simple fault analysis to complete detailed performance testing of major units and/or auxiliaries. Scanning and digital techniques seem best suited for this service because the potential number of readings is large and the programming complex and variable. Since the service is not continuous, the burden on the scanning and digital conversion equipment is not severe. Thus reasonable performance without excessive maintenance may be expected.

On the smaller steam-electric generating units the use of three distinct groups of instrumentation is not practical. The savings are insufficient to justify the cost of including and servicing precision measuring devices and data-processing equipment. However, on the larger units of today and the future, potential savings are so great and advantages so obvious that there seems to be no question about this being the future pattern.

Advantages of segregating operating guides and precise performance and test instrumentation are:

(1) The control center for large steam-electric generating units with complex auxiliaries can be simplified since the operator will need only continuous indicators or records necessary for guiding him in the reliable operation of the unit. Many measurements of temperature, pressure, pressure losses, flows, etc, now used in the control center can be eliminated.

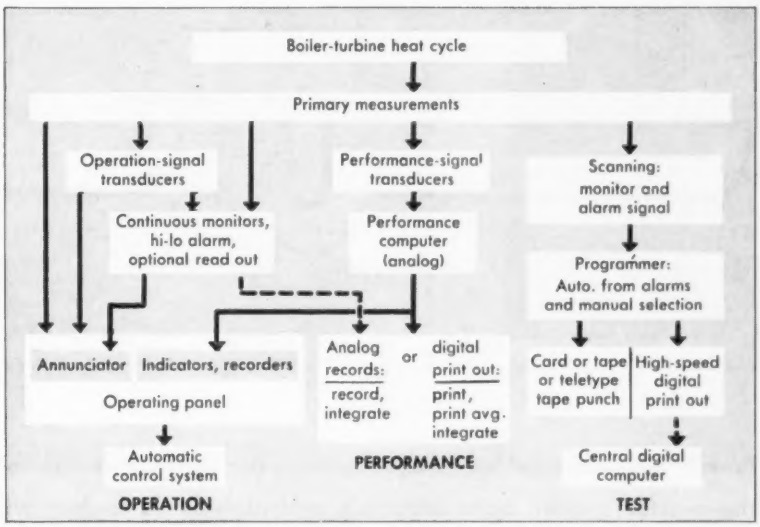
(2) Precise performance data will be gathered and processed outside the control center. The operator will receive only results and pertinent information to guide him in correcting faulty performance.

(3) Incremental cost data can be sent continuously and directly to the load dispatcher for economical system loading.

(4) Data-processing equipment will prepare permanent continuous records of output, input and overall and individual unit performance in a form suitable for direct cost accounting.

(5) Need for a large results department to collect and interpret data from the plant and the need for expensive testing programs will be eliminated.

(6) Complete test data taken and interpreted continuously during the early stages of operation will lead to earlier correction of design faults, enable builders to improve designs on subsequent units.

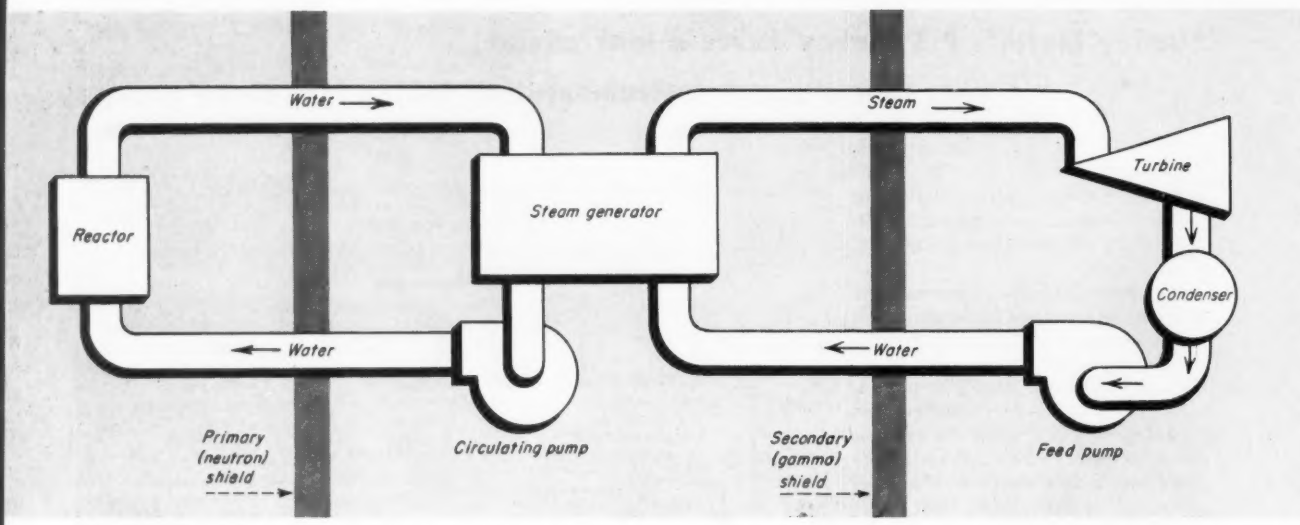


SCHEMATIC ARRANGEMENT for separate operation, performance, test instruments

Acknowledgment

Power wishes to thank the following organizations for their generous cooperation in the preparation of this report: Bailey Meter Co, Cleveland, Ohio; *Control Engineering*, McGraw-Hill Publishing Co, Inc, New York, N. Y.; Fischer & Porter Co, Hatboro, Pa.; The Foxboro Co, Foxboro, Mass.; Gulf States Utilities Co, Beaumont, Texas; Leeds & Northrup Co, Phila., Pa.; Minneapolis-Honeywell Regulator Co, Phila., Pa.; Panellit, Inc, Skokie, Ill.; Republic Flow Meters Co, Chicago, Ill.; Scam Instrument Corp, Chicago, Ill.; Taylor Instrument Cos, Rochester, N. Y.; Westinghouse Electric Corp, Pittsburgh, Pa.

*Abstracted from ASME paper No. 56-F-14. *Instruments and control—key to economical performance of steam power plants,* by P S Dickey, President, Bailey Meter Co, Cleveland, Ohio



PRESSURIZED-WATER nuclear plant with reactor system, *left*, primary coolant system, *center*, secondary or steam system, *right*

Pressurized-water-cooled nuclear reactors are fertile grounds for corrosion. But knowledge of the reactor system, right materials and high-purity coolant will help you meet . . .

Today's challenge of nuclear corrosion

Here's what corrosion can do

1. Cause loss of mechanical strength owing to metal oxidation or intergranular penetration and eventual material failure
2. Perforate any thin section material such as the fuel-element cladding or the boiler tubes
3. Produce temporary or long term contamination of external system from corrosion products which become radioactive when passing through reactor
4. Result in efficiency loss when corrosion products deposit on the heat-transfer surfaces

By **ROBERT F KOENIG**
General Electric Co
Missile and Ordnance Systems Dept

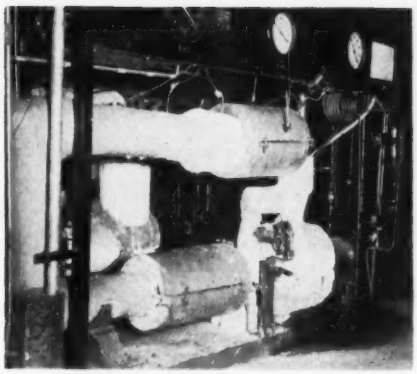
► EXAMINE the reactor power plant system in the schematic diagram above. The *Nautilus* and a number of other naval vessels and stationary power plants use this type reactor. You should have a basic understanding of its operation before tackling the special corrosion problems involved.

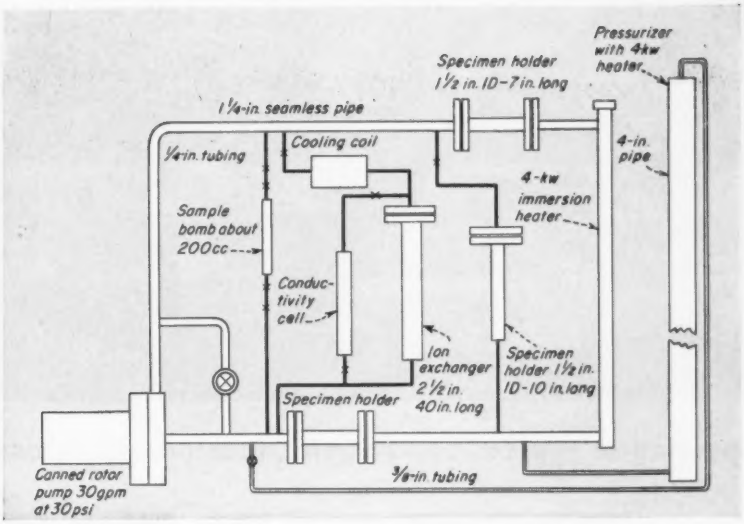
Power plant system can be divided into three general areas. Left-hand area contains the reactor with high levels of neutron and gamma irradiation. This area is permanently radioactive and inaccessible when the reactor is run at full power. Middle area is actually located around the reactor and inside the reactor compartment. Here neutron radiation is at a low level, but gamma radiation level is high because of activity induced in the water. This area can be entered after reactor shutdown when radioactivity has ebbed to safe levels. Right-hand area, containing the steam system is not radioactive and is normally accessible for operation and maintenance.

The reactor itself is a pressure vessel containing a number of fuel and control elements. Alloys or compounds of uranium, used for fuel, are jacketed to contain the fission products and prevent any corrosion of the fuel "meat."

Heat generated by reactor fuel elements is transferred to pressurized water passing through the reactor vessel. Steam generator in the primary coolant system receives this hot water and uses the heat to produce steam for a conventional turbine. Pressurized water is then pumped back to the reactor for further heating and a continuous repeat of the whole cycle.

Why worry about corrosion? Box, left, gives four of the main reasons why corrosion worries nuclear engineers. Radioactive corrosion products are particularly troublesome because of the accessibility problem they create. Induced radioactivity in water decays to tolerable levels in minutes. Nitrogen, the radioactive constituent in water produced by oxygen-16 neutron capture (neutron in, protron out), has a half life of only 7.3 seconds. If there are no impurities in the primary coolant it is possible to enter the reactor compartment a few minutes after shutdown. But, since the coolant is never completely free of impurities, the reactor compartment is radioactive for longer periods because of impurities with greater half lives. Short term radio-





CANNED-ROTOR PUMP is a part of the . . . **CIRCULATING TEST LOOP** which duplicates the reactor's service conditions

Choose materials carefully for pressurized-water reactors

activity can be eliminated by diluting the coolant with fresh water. Long term radioactivity requires decontamination of the reactor compartment.

Nature of coolant. Pressurized water used as the coolant must be kept at high-purity levels to avoid contamination of the reactor compartment external to the reactor. Total solids concentration in the order of ppm is necessary. Even with the most corrosion resistant materials, dissolved corrosion products must be removed by continuous by-pass purification equipment. Water-treatment systems in current use keep the coolant resistivity as high as 1 megohm-cm.

Oxygen is perhaps the most corrosive contaminant. Since the primary coolant system is completely enclosed and recirculated, any oxygen in the water initially is consumed by corrosion. Metal-water reactions produce the free hydrogen found in the coolant. When air-saturated water is used for startup the coolant equilibrium condition is alkaline from the presence of ammonia synthesized from nitrogen and hydrogen in the reactor.

If large slugs of air get into the primary coolant, the alkaline equilibrium is upset. Synthesis of nitric acid may occur as water containing air passes through the reactor. An acid pH can be produced to accelerate corrosive attack on materials, such as chromium, that are susceptible to this kind of attack. Fortunately, this aggressive condition is short lived. Hydrogen, liberated by corrosion reaction, combines with (*Continued on page* 180)

Cobalt or tantalum alloys are not desired because their radioactive isotopes are long lived. Cobalt-60 has a half life of 5.3 years and tantalum-182 has a half life of 112 days. This outweighs the fact that cobalt does have excellent resistance to corrosion in water up to temperatures of 680 F. Any corrosion products of either material become radioactive passing through the reactor and are distributed throughout the primary coolant system external to the reactor. Decontamination is then required before starting any extensive maintenance operations.

Beryllium, aluminum, magnesium and their alloys are not considered suitable for unclad use in water at 500 to 700 F. This is true despite the fact that aluminum does have good corrosion resistance at low temperatures.

Chromium, titanium, nickel and their alloys. First two materials have excellent resistance to corrosion in water up to 680 F. Nickel and nickel-base alloys have good resistance up to 500 F in water with an excess of hydrogen. However, both chromium and nickel alloys are susceptible to increased attack by water containing oxygen.

Copper and silver alloys have excellent corrosion resistance in low-temperature water but corrode so rapidly above 500 F that they cannot be used for any extended high-temperature operation.

Gold and platinum retain their nobility even up to 650 F and higher. Autoclaves have been lined with these materials to get a noncontaminating environment for special tests.

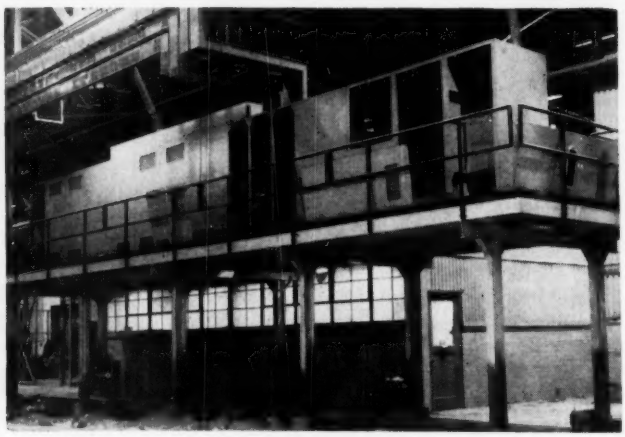
Uranium and thorium are fissionable fuel materials that must be jacketed because of their rapid reaction with hot water. Some very dilute alloys of uranium show fairly good corrosion resistance, but still must be clad to contain fission fragments.

Zirconium alloys are now in demand for reactor use because of their very low neutron capture cross sections. Exceptionally high resistance to corrosion in water and steam is obtained. The two alloys in general use today are: Zircalloy 2, containing 1½% tin and small amounts of iron, nickel and chromium; and Zircalloy 3, containing ¼% tin and ¼% iron. Both have desirable reactor property of not shedding corrosion products.

Ferrous alloys are most widely used. Primary coolant systems of pressurized-water reactors have been constructed of stainless steel. Initially, stabilized grade 347 was preferred, but testing under a wide range of conditions shows that 304 stainless steel, even in the as welded condition, has enough corrosion resistance. With this material, corrosive-acid-cleaning operations must be avoided after welding or stress relieving.

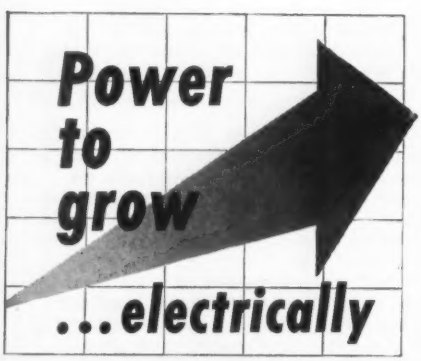
Spurting in typical Los Angeles fashion, this sprawling metals plant . . .

spotted heavy subs outdoors . . .



lighter subs indoors for a . . .

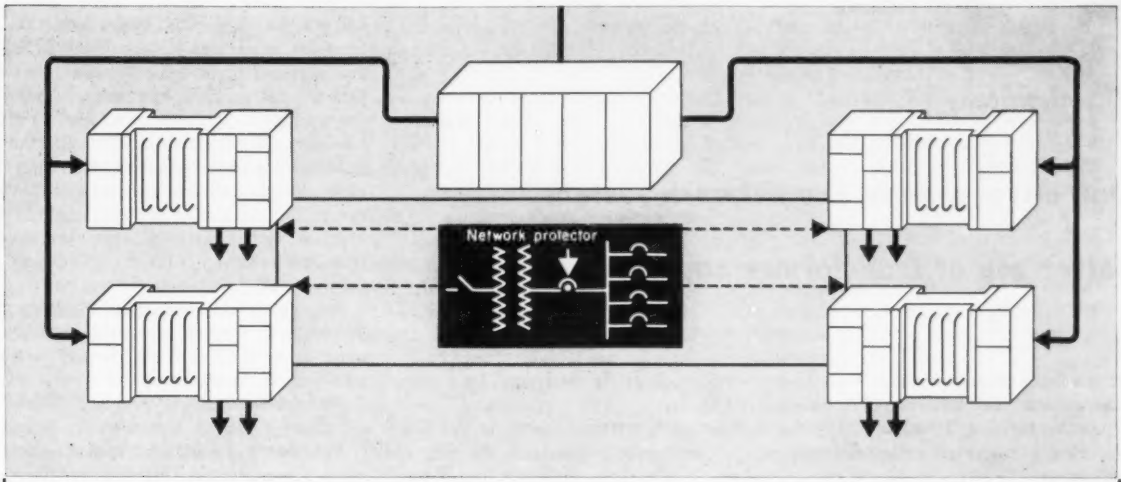
Spot network distribution: PTG choice



NO. 8: NETWORK DISTRIBUTION

► HUMAN INERTIA, coupled with the ever-present desire to hold capital expenditures down, are perhaps the two most common reasons found for not scrapping an out-dated electrical distribution system in favor of a completely new scheme when a major plant expansion is being weighed. In all too many cases the existing system, with its possible shortcomings and voltage limitations, is merely extended. True, in many plants where the initial system was originally well-designed and suitable for truly economical expansion, this route is by far the most practical. That's the goal for all PTG planners.

One company that deviated completely from an existing system in face of a major plant expansion was Harvey Aluminum, a division of Harvey Machine Co, Inc, Torrance, California. Major expansion came about when the U.S. Air Force selected Harvey Aluminimum to step in on their Heavy Press Program. New giant presses and auxiliary equipment had to be fed and housed. Electrical power needs were sizable since the new presses included a 12,000- and 8000-ton hydraulic extrusion unit, a 3-million and 1½-million-pound hydraulic stretch-straightener plus a complement of secondary metal-working machines. The big 12,000-ton unit is billed as the largest extrusion press built in the U.S. It permits Harvey to produce aluminum alloy



How a network scheme works when trouble strikes

Industrial secondary network systems operate with the network protector as the core. Protector, if it has a full compliment of protective equipment, consists basically of an electrically operated air circuit breaker, automatically controlled by a power directional tripping relay and reclosing relay.

Overcurrent protection is either by fuses in series with the network protector or direct-acting trips on the protector's air circuit breaker portion. When either the primary feeder or transformer faults, a directional relay closes contacts on reverse power flow, tripping all network protectors connected to the faulted feeder. This action automatically isolates a primary fault without dropping load. During the several cycles it takes to open the primary feeder breaker, voltage on the network may go to almost zero.

As pointed out in the AIEE booklet *Electric Power Distribution for Industrial Plants*, voltage will then rise some 50% or more while the proper network protectors open. After the fault is cleared and voltage restored the protectors automatically reclose. But reclosing will occur only when voltage conditions are such that power flow will be from primary to secondary. Costwise, a secondary network system may run twice that of a radial scheme.

for this fast-growing California plant

extrusions of unprecedented weight, length and crose section.

Harvey's new needs called for a top-drawer electrical distribution system to handle shifting loads with assurance of service continuity. After studying all the possible distribution schemes available (POWER, Oct 1953, pp 88-91) Harvey engineers selected an in-plant network system as the one best-suited for their new load requirements. Service continuity, voltage regulation and efficient use of installed transformer capacity are the basic reasons given by Harvey engineers for their choice.

Many circuit arrangements are possible for industrial plants. They range from the simple radial through the secondary selective, primary selective, looped primary and secondary network. By way of review: In the simple radial arrangement there is but one primary feeder connected to one secondary transformer at the load center. Earlier types of radial systems used an outdoor transformer supplying load through a series of low-voltage secondary feeders. For some years now, the design trend favors running the high voltage right to a transformer located at the load centers. Dollar-wise, the radial setup generally proves to have lowest initial cost since there is no equipment duplication.

Secondary selective arrangement is the next step where a slightly greater degree of flexibility and service continuity is demanded. Here a normally-open bus-tie breaker connects secondary sides of substation pairs. Each substation normally operates independently of each other, just as in a straight radial hookup. But on a forced or scheduled outage of one primary feeder or transformer, the main breaker in the affected sub is opened and the tie breaker closed. *Result:* Energized sub picks up all load.

Primary selective differs from the simple radial and secondary selective in that two primary feeders are brought to the secondary substation. Through a switching arrangement, either primary feeder can be selected as source

Power to grow ...electrically continued

One advantage of the network system; better use of transformer capacity

for the secondary substation. Cost of a primary selective scheme with power circuit breakers will run to 125% the cost of a comparable secondary selective system.

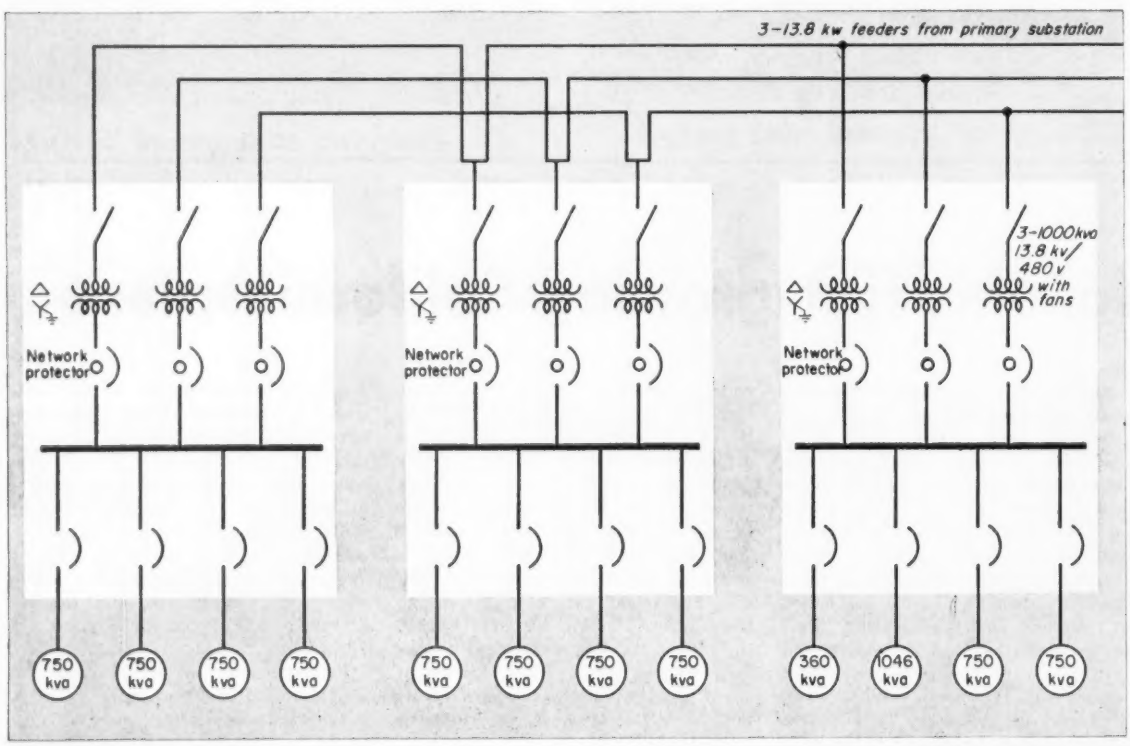
Looped primarys are another distribution scheme. Here the primary feeder actually loops through dual switches in the secondary substation with the substation tap taken midway between both switches. Most serious hazard of this system is the possibility of switching under high overload or fault current. The looped primary scheme finds its niche where centers of load are far apart and primary service can easily feed them by a looping feeder.

Network system adopted at the Harvey plant gets power from the City of Los Angeles Dept of Water and Power at 13.8 kv through two incoming circuits. Each circuit supplies power to a section of 15-kv switchgear made up of 11 cubicles—incoming line, metering, tie-breaker, 8 feeder breakers. The tie breaker connects both sections of the 15-kv switchgear. Normally open tie breaker is key interlocked with two incoming circuit breakers. This setup permits carrying the entire plant load through either incoming circuit.

Heavy loads, including motors from 150 to 800 hp, plus large induction furnaces, are fed at 4.16 kv. Such loads are supplied from four 3-phase transformers rated 4500 kva each. These fan-equipped transformers feed the load through 12 circuits. Then, for the balance of plant expansion, seven spot-network type substations supply 480-v power for remaining motors, small induction and resistance type heating furnaces and ovens plus the 460-v mercury-vapor lighting.

Spot-network distribution scheme, according to Harvey engineers, was the most economical form of network system for this installation since two or three transformers are grouped closely together to feed a common bus.

Real heart of a network system is the network protector. This is a specially designed switching device arranged so it opens under a power reversal. Note form sketch, below, that the network protector is spotted between secondary bus and power transformer. Protector's job is threefold: (1) Open under fault currents that may flow into the power transformer from the network bus, thus protecting the system from effects of a power transformer failure. (2) Automatically close when its associated sec-



DRY-TYPE TRANSFORMERS, rated 750-kva nominally, serve as spot networks along with three 1500-kva oil-filled units. Future fans on dry-type units can boost ratings 1/3. Dry-type impedances figured to hold fault currents at 50,000 amp max

ondary transformer builds up a voltage of proper magnitude and phase relationship. Thus the incoming unit can immediately start carrying its share of load. (3) Remain closed under momentary power reversals or load swings that send small shunks of power from network bus into primary system.

Dry-type transformers, rated 750-kva, serve as spot networks along with three 1500-kva oil-filled units. Future forced cooling can raise the dry-type rating to 1000 kva. This means an ultimate capacity of 3000 kva for three dry-type transformers.

Short-circuit currents were carefully studied by Harvey engineers before equipment was selected. Resulting transformer impedances of the dry type units are such that short circuit currents are held to a 50,000 amp maximum. The 1500-kva transformers form a 4500-kva network with impedances chosen so fault currents are held below 75,000 amp including limited motor contribution.

As already mentioned, one of the significant advantages of the spot network system is the efficient use of transformer capacity. *Example:* Typical furnace consists of four single-phase 200-kva induction coils representing a maximum single-phase load of 400-kva. Smallest 3-phase transformer to feed such a load must be rated 1200 kva, or 1500 kva if the next standard size is adopted. Of this figure only 800-kva could be used. And in the case of a 1200-kva transformer, no appreciable 3-phase load could be connected. So with the spot network system it is possible to connect three such furnaces into a single network thereby balancing the loads, making the full network capacity usable.

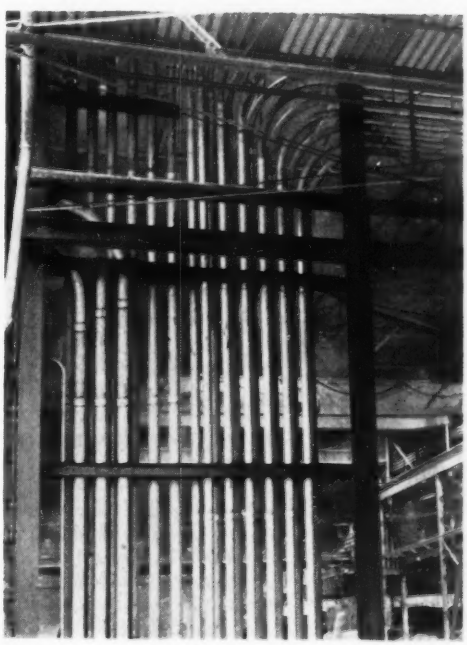
Alternate scheme, using Scott connected 2-phase transformers calls for some off-beat transformer hookups. Even so, no regular 3-phase industrial load could be added.

With three transformers fed from three primary feeders, plus network protectors and low-voltage circuit breakers performing their protective functions, Harvey engineers have cornered a high degree of service continuity. Right now a power-transformer or primary-feeder failure would be cleared without even a momentary outage on the network bus. No need to restart machinery or mercury vapor lighting as with automatic transfer setups. This is an important factor where lighting connects to the general power source.

Each primary feeder supplies three or four transformers in different spot networks. So failure in any primary cable or transformer trips out the governing primary breaker. If fault is located in a transformer, affected unit can be isolated by a primary disconnect switch. Balance of transformers are then returned to service. The maintenance angle is appealing too since any transformer can be removed from the network bus without shutdown. This is an important angle in time of trouble or routine maintenance of power transformers, primary cable, high-voltage circuit breakers.

Another important feature in favor of the spot network system is the already-mentioned better possible utilization of all installed transformer capacity. *Example:* Three transformers in a radial system each having a 100-kva spare capacity would rule out addition of a 200-hp motor. But this motor could be connected to spot-network system.

Weekend or night loads can be handled with fewer transformers thus reducing no-load losses without trimming back service on any part of the Torrance plant. Harvey engineers feel their choice of a network system gives them top service continuity, flexibility, diversity . . . and that's what they wanted.



Conduit is the raceway here

Although conduit rather than interlock armored cable or trays and ducts got a heavy play on this job, this is not a true picture of today's trend.

True, rigid conduit has been the backbone of industrial wiring systems for generations. In the days of lower labor costs, necessary time for threading, cutting and bending wasn't as critical. And there was no substitute that offered all the advantages of conduit: top mechanical protection, good electrical conductivity.

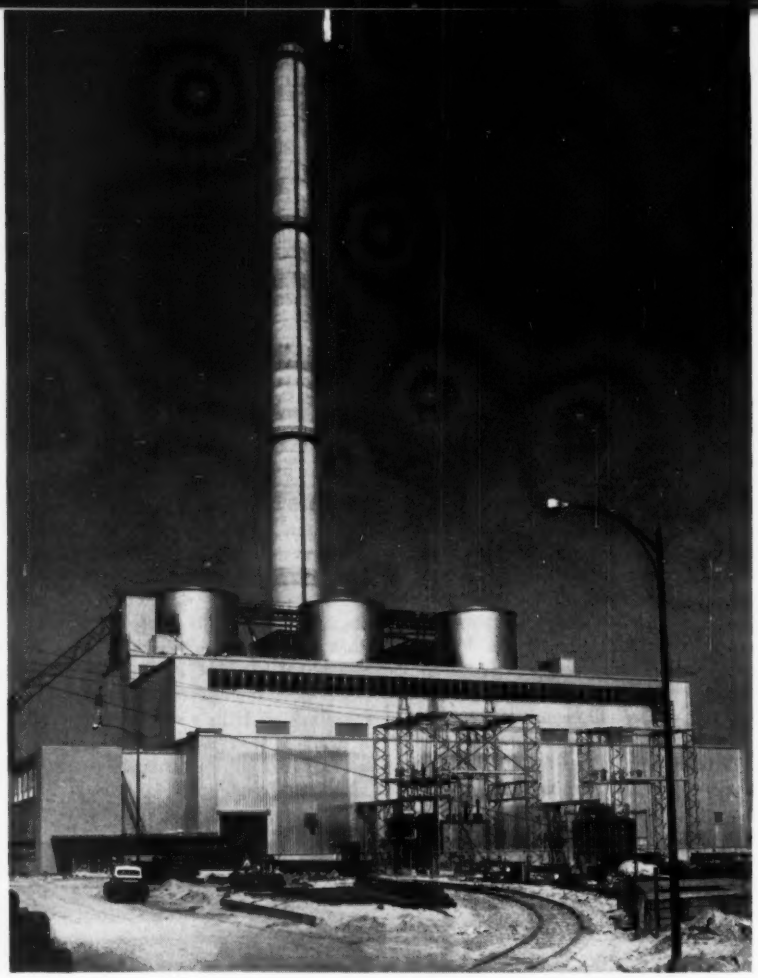
During the 1930's, thinwall conduit began cutting its teeth in industrial plants. It offered lightweight, easier cutting and, of greater value, no threading. But thinwall was just the start of a concentrated effort to find easily installed raceways.

Trays and ducts are being used today where many wires or cables are to be carried in the same general area. Typical would be control wiring and low-voltage secondary feeders. Trays are available prefabricated, complete with fittings to dodge around obstructions. (POWER, Feb 1957, p 90, 91).

Is rigid conduit on its way out as a raceway in industrial plants? Far from it. Where top mechanical protection is needed there is no true replacement for heavy-wall rigid conduit.

Good neighbors:

- **Delaware Power & Light Co gains a new customer for power and process steam**
- **Tidewater Oil Co finds a tailored-made market for its by-product fuels**
- **Both companies gain big economic advantages by unique power arrangement at DP&L's . . .**



THREE 500,000-lb-hr boilers power the first station designed to burn fluid coke

Delaware City—First station designed to burn fluid coke

► DEMONSTRATING FAITH in the adage that two heads are better than one, Delaware City Station and Tidewater's Delaware Refinery have set up a beneficial share-the-wealth plan. The power station, part of Delaware Power & Light Co's system, uses fluid coke as primary fuel. It is, in fact, the first large generating station, in the U.S., designed to do so. (See "Fluid coke—Newest steam plant fuel," POWER, Dec 1955, p 102).

With one first to its credit, DP&L got together with Tidewater and came up with a unique method of operations. *Result:* The power station supplies the refinery with power and process-steam; the refinery furnishes the power station with fuel, treated water and cooling water.

Far-sighted thinking by Tidewater and DP&L led to planning and execution of this cooperative project. The oil company's new refinery, and the utility's power station were built at the same time, about 15 miles south of Wilmington, Del. Engineering, design and field construction of both were handled as one project.

Fluid coke (end product of a new refining process developed and patented by Esso Research & Engineering Co) has a calorific value of over 14,000 Btu per lb, burns with less than 0.5% fly-ash. The refinery's 42,000-bbl-per-day-input fluid coker—the world's largest—produces this primary fuel for the power station. And the refinery also provides the supplementary gas or oil

Based on paper "Power and Steam for the Delaware Flying A Refinery." AIEE Conference paper No. CP 56-897 by Wm C Cauthen, C F Braun Co. Presented at the AIEE Summer General Meeting, San Francisco, Calif., 1956.

fuels needed to bring the fluid coke to ignition temperature and keep it burning. (See drawing, top of p 88.)

Demand for 600-psig process steam varies from 300,000 to 800,000 lb per hr, depending on (1) kinds and qualities of crudes being processed and (2) the particular operating cycle. Having the largest initial capacity ever built —130,000 bbl of crude per day—the refinery's power needs range from an 18,000-kw low to more than 40,000-kw peak. Such power and steam demand made a tie-in with DP&L an attractive solution.

Power station's three 2-drum water-wall-type slag-bottom boilers each produce 500,000 lb steam per hr at 1300 psig, 950 F. The following four steam levels supply both power station and refinery: (1) boilers at 1300 psig, 950 F, (2) automatic extraction to the refinery at 600 psig, 750 F (3) station auxiliaries, 175 psig, 425 F (4) space heating, steam tracing, 40 psig, 380 F.

Two main steam headers carry 600 psig to the refinery from a controlled backpressure extraction point on each turbine. And each turbine is served by two high-pressure feedwater heaters. The first heater takes bleed steam from the 10th stage; the second heater from the 7th stage. A pegging steam line holds feedwater at 285 F, despite variations in turbine extraction flow.

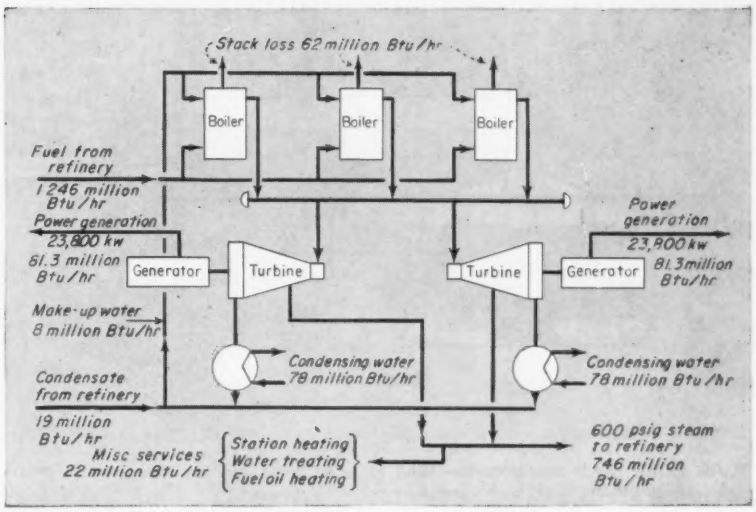
The generators, two 25,000-kw 3600-rpm extraction-condensing units, have a maximum practical extraction rate of about 520,000 lb per hr. With no 600-psig extraction, each unit delivers 20,000 kw. They're rated 32,000 kva, at 85% pf with 30-psig hydrogen cooling. Output is 13.8 kv, 60 cycles.

Though the three boilers and two turbine-generators carry the full load of the refinery and the station's auxiliaries, they're backed up by an independent 69-kv tie-line from the DP&L system. The line can (1) take surplus power from the station or (2) supply needed power to the station bus if one or both turbines are shut down.

Water treatment from a central plant, owned by Tidewater but operated by DP&L, supplies both power station and refinery needs for pretreated, demineralized and zeolite-treated water.

Pumping equipment, housed in Tidewater's Pumping Station, supplies 45,000 gpm of condensing water to the power station via a 60-in. line. A 66-in. gravity-outfall line returns the water to the river.

Electrical system has bus duct, circuit breakers and switchgear arranged to accommodate installation of a future generator. Two 20/26.7/33.3-mva (OA/FA/FA) transformers connected to the 69-kv system through an outdoor substation and switchgear provide 100%



CONDENSING-EXTRACTION CYCLE at station has a fuel-power economy of about 43%. Constant high load factor contributes much to station's overall economy

Net heat rate calculations

Total boiler steam made	= 990,300 lb/hr	h = 1468 Btu/lb
600-psig steam to refinery	= 540,000	h = 1381.5 Btu/lb
Refinery condensate returned	= 310,000	h = 61 Btu/lb
Demineralized-water temperature	= 65 F	h = 33 Btu/lb
Boiler blowdown	= 1,200 lb/hr	h = 593 Btu/lb
Boiler efficiency	= 86%	
Total power generated	= 47,600 kw	
Station power required	= 9,500 kw	
Power to refinery	= 38,100 kw	

Heat absorbed*:

(990,300) (1468) – (960,300) (427.7) – (30,000) (249.8) = 1,034,000,000 Btu/hr

steam from boiler – feedwater – desuperheating water = heat absorbed

Heat chargeable to refinery:

(540,000) (1381.5 – 61) + (230,000) (61 – 33) = 720,000,000 Btu/hr

Power required to make refinery steam:

$$\frac{540{,}000}{990{,}300} \times 9500 = 5180 \text{ kw}$$

Correcting for lower feedwater pressure: 5180 – 1000 = 4180 kw

Power required for power generation:

9500 – 4180 = 5320 kw + 280 kw** = 5600 kw

Net station heat rate:

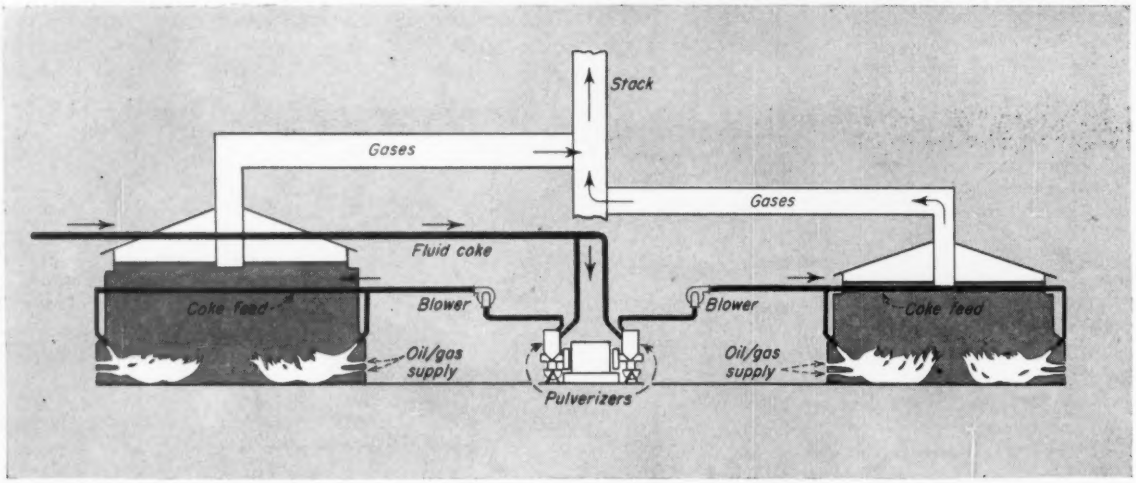
$$\frac{1{,}034{,}000{,}000 - 720{,}000{,}000}{(47{,}600 - 5600)\ (0.86)} = \frac{314{,}000{,}000}{(42{,}000)\ (0.86)} = 8690 \text{ Btu/kwhr}$$

*Neglecting 200,000 Btu/hr absorbed by blowdown

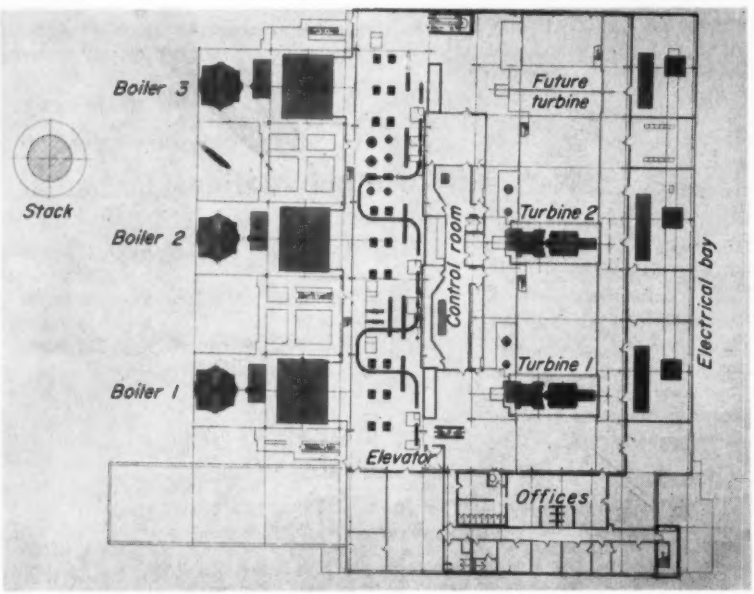
**Includes pumping 30,000 gpm of cooling water against 25-ft head and portion of water-treater load

Notes: (1) All heat contents based on zero for liquid water at 32 F

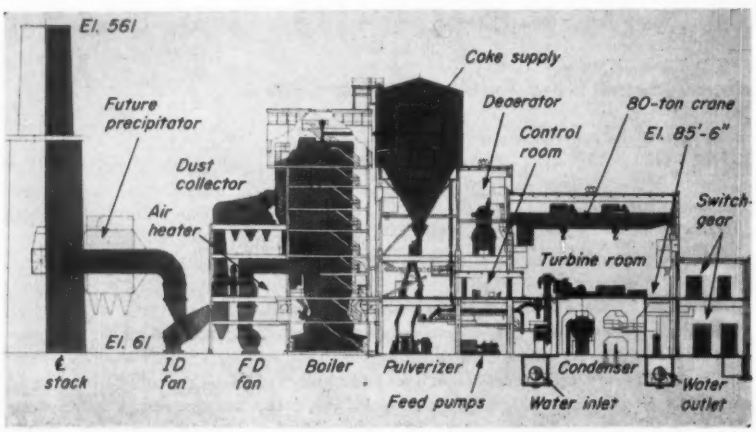
(2) Power requirements for generating 600-psig steam are assumed to be the same as for 1300-psig steam, except for power required for feedwater pumping. Station power requirements are higher than usual, because fluid coke is harder to pulverize than coal.



FLUID COKE needs supplementary fuel to bring it to ignition temperature, keep it burning. Schematic shows typical setup



MAIN OPERATING FLOOR PLAN shows how all mechanical and electrical equipment is sized and arranged to tie in with one or more additional turbine-generators



CROSS-SECTION shows location of soundproof air-conditioned centralized control room. Room has all essential controls, space for future boiler and turbine panels

DELAWARE CITY continued

standby capacity. The station's 13.8-kv switchgear serves 28 feeders to the refinery plus the station's auxiliary loads.

Central control room, soundproofed and air-conditioned, brings together all instruments and controls essential to station operation. It's divided into two sections—One controls two boilers and two turbines, the other controls one boiler and provides control space for a future boiler and two turbines. For startup, local panels control each boiler, turbine and major auxiliaries.

Combined generation of power and process steam results in a favorable net-heat-rate of about 8700 Btu per kwhr. The Delaware City Station produces process steam in high-efficiency boilers with less fuel than would be required to generate the same amount of steam in conventional lower-pressure boilers.

Both Tidewater Oil Co and Delaware Power & Light gain distinct economic advantages through this setup. Tidewater is assured of a steady market for by-product fuels, plus a reliable source of power and steam for its new refinery. Delaware Power & Light gains a valuable customer for power and by-product steam.

PRINCIPAL POWER PLANT EQUIPMENT

Delaware City Station, Delaware Power & Light Co., Delaware

Steam production equipment

Steam generators, 3 — Riley Stoker Corp
500,000 lb per hr continuous, 1428-psig drum, 1300-psig superheater outlet at 950 F. Pressure boiler setting with suction furnace, 12 directional flame burners on one level. Each burner has three pulverized fuel nozzles, two gas guns, one Peabody mechanical atomizing oil gun. Superheaters; convection-radiant, with spray desuperheater system; heating surface 24,502 sq ft. Desuperheaters; steam assisted spray type system

Air heaters, 3 — Air Preheater Corp
Ljungstrom regenerative, vertical shaft, 45,900 sq ft

Fans, 3 f-d, 3 i-d — Westinghouse Electric Corp, Sturtevant Div
F-d fans: 900 rpm, constant speed, 842,000 lb per hr air at 100 F and 10.3-in. wg, double inlet, inlet vanes, outlet damper. I-d fans: 720-rpm constant speed, 940,000 lb per hr flue gas at 435 F and 14-in. wg. Inlet louver damper control

Flyash reinjection system — Clarage Fan Co
Three type O fans powered by 125-hp motor drive, 1800 rpm. Ducts transport material back to pulverizer inlet

Soot blowers, 12 — Copes-Vulcan Div, Blaw-Knox Co
Model T-2-E retractable air blowers, pushbutton control, 300 psig at blower heads

Slag-handling system — United Conveyor Corp
Water jets to surge tank, jet pulsion pump to settling basin

Power-generating equipment

Turbine-generators, 2 — General Electric Co
25,000 kw, 3600 rpm, 1250 psig, 950 F extraction-condensing. One controlled, three uncontrolled extraction points, exhaust 2½-in. Hg, 32,000 kva at 30 psig hydrogen pressure, 0.85 pf. Exciters, two tandem mounted, 3600 rpm, 125 kw, 250 v, shunt-wound. One spare exciter, 125 kw, 250 v, 1800 rpm, motor drive

Surface condensers, 2 — Worthington Corp
Horizontal 2 pass, divided waterbox, 16,000 sq ft each, 100,000 lb per hr, 70-F cooling water

Circulating-water pumps, 9* — Byron Jackson Div, Borg-Warner Corp
Vertical, 2000-hp motors, 600 rpm, 34,500 gpm at 180-ft head
*River Pumping Station supplies circulating water to Tidewater Refinery and Delaware City Station

Vacuum pumps, 3 — Worthington Corp
Horizontal reciprocating, 2 stages, single-cylinder dry vacuum, 77 lb per hr at 0.7368 psia, motor driven, 296 rpm

Feedwater equipment

Condensate pumps, 4 — Ingersoll-Rand Co
Vertical, 7 stages, 1750 rpm, 400 gpm at 114-psig differential head

Boiler-feed pumps, 6 — Pacific Pumps, Inc
Horizontal, double case, 11 stages, 3580 rpm, 750 gpm at 1600-psig differential head. Pump temperature 250 F, 1000-hp constant speed motor

Feedwater heaters, 4 — C F Braun, Inc
Vertical, closed shell, U tube, 2 pass, integral drain coolers, 750,000 lb per hr. 2000 psi, ⅝-in. OD, 18-gage monel tubes. One 5400 sq ft and one 4140 sq ft per turbine

Deaerators, 2 — Cochrane Corp
750,000 lb per hr, horizontal tray, 10-min surge capacity from bottom to normal liquid level

Feedwater treatment

Demineralizers, 4 — Permutit Co
Gravity filters, 4, 790 gpm each. Clarifiers, 2, 1600 gpm each. Vacuum degasifier, 1. Exchangers, cation, 4, anion, 4

Storage tank, 1 — Chicago Bridge & Iron Co
Capacity, 1,000,000 gallons

Fuel-handling equipment

Fuel-oil heaters, 2 — C F Braun Co
195,000 lb per hr oil. Temperature in 150 F, out 210 F, horizontal oil in tubes, steam supply; 157 psig at 418 F

Fuel-oil pumps, 3 — Sier Bath Gear & Pump Co
Horizontal screw, 1130 gpm at 160 F, 650 psi discharge, 1150 rpm

Coke pulverizers, 9 — Riley Stoker Corp
Duplex, attrition established rating: 8 tons per hr each

Pulverizer feeders, 18 — Riley Stoker Corp
Star type, variable-speed Reeves drive

Coke-storage silos, 3 — Chicago Bridge & Iron Co
Steel, 1335 tons each

Dust-handling equipment

Dust collectors, 3 — Prat-Daniel Corp
Mechanical, 390,000 cfm at 875 F and 91% efficiency. Dust into flyash reinjection system for removal

Instruments and control systems

Combustion and feedwater control — Bailey Meter Co
Fuel-oil pressure control — Spence Engineering Co
Superheat control — Bailey Meter Co
Desuperheating stations — Republic Flow Meters Co
Boiler meters — Bailey Meter Co
Temperature recorders — Minneapolis-Honeywell Regulator Co
Boiler-drum-level gage glasses — Yarnall-Waring Co
Remote level indicators — Yarnall-Waring Co
Boiler-drum-level recorders — Bailey Meter Co
Ashcroft pressure gages — Manning, Maxwell & Moore Inc
Indicating thermometers — Taylor Instrument Cos
Pressure-temperature transmitters — Taylor Instrument Cos
O_2 recorders — Bailey Meter Co
Alarm systems — Panellit, Inc
Control-room boards — Panellit, Inc

Miscellaneous equipment

Instrument air dryers, 2 — Selas Corp of America
Dual tower, activated alumina, 150 scfm

Instrument air compressor, 1 — Worthington Corp
Horizontal, single-stage, nonlubricated, reciprocating, 195 scfm, 100 psig, 300 rpm

Soot blower air compressors, 2 — Ingersoll-Rand Co
Three stages, heavy duty, reciprocating, 667 scfm, 500 psig, 350 rpm

Soft cooling-water pumps, 2 — Ingersoll-Rand Co
Single-stage, centrifugal, 2000 gpm, 53-psig discharge, 1150 rpm

Auxiliary power switchgear — General Electric Co

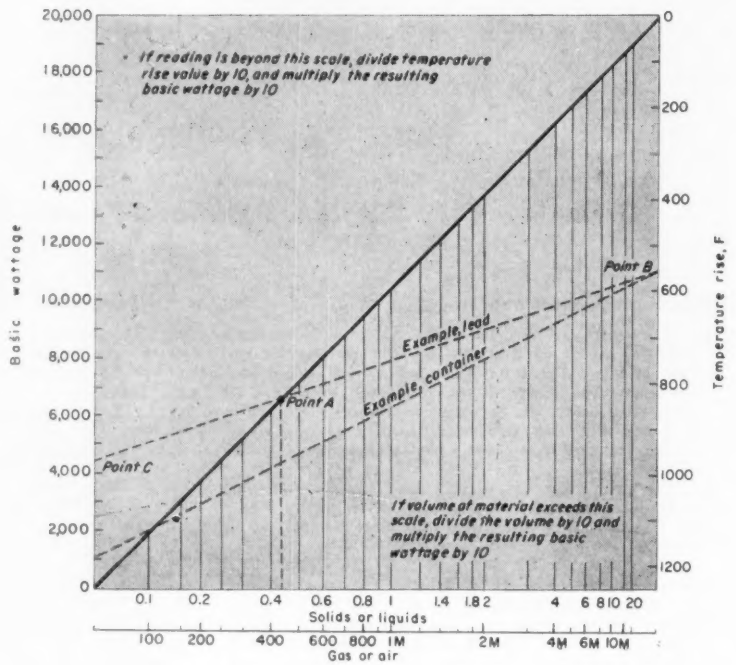
Auxiliary power transformers, 6 — General Electric Co
5000/6250 kva, 13.8/2.4 kv

Motors — Westinghouse Electric Corp
General Electric Co

Builders — C F Braun & Co

8 steps to find watts needed to heat material to desired temperature . . .

1. Calculate or estimate cu ft (or cu ft per hr) of material to be heated
2. Locate point on diagonal line of graph directly above number of cu ft of material to be heated
3. Find temperature rise of material (final desired temperature minus starting or air temperature) and locate its point on scale at right
4. Connect points in 2 and 3 with a straight edge that crosses left scale. Point on left scale is *basic wattage*
5. Multiply *basic wattage* by *basic constant* (in table) to get watts needed
6. To melt or vaporize material, multiply cu ft by wattage given in table
7. Repeat *1* to *5* for all objects that must be heated—racks, trays, etc
8. Add *5* + *6* + *7* for total wattage for 1 hr. To heat material in 3 hr, divide by 3; in ½ hr, multiply by 2, etc



Constants of materials

SOLIDS	Basic constant	Pounds per cu ft	Melting point F	Watts per cu ft to melt
Aluminum	.59	160	1216	22400
Asphalt	.42	65	250	2600
Brass	.84	525	1700	———
Brick or masonry	.49	140	———	———
Carbon	.47	144	———	———
Copper	.89	555	1981	41600
Glass	.53	165	2300	———
Iron, cast	.94	450	2200	———
Iron, wrought	.92	480	2800	———
Lead, solid	.35	710	621	7100
Lead, melted	.46	———	———	———
Nickel	.96	550	2642	———
Paper	.42	58	———	———
Paraffin	.63	56	133	3530
Porcelain	.33	80	———	———
Rubber	.61	95	———	———
Sand	.31	100	———	———
Silver	1.00	655	1761	24900
Solder—50-50	.37	580	415	9860
Steel	.92	480	2550	———
Sugar	.50	105	320	———
Sulfur	.41	125	230	2120

SOLIDS	Basic constant	Pounds per cu ft	Melting point F	Watts per cu ft to melt
Tin, solid	.41	455	450	11400
Tin, melted	.47	———	———	———
Type metal 85% lead	.43	670	500	7600
Wood, pine	.24	34	———	———
Wood, oak	.36	50	———	———
Zinc	.68	445	787	22700

LIQUIDS	Basic constant	Boiling point F	Watts per cu ft to vaporize
Acetic acid	.50	245	2970
Alcohol	.57	172	5900
Benzine	.40	175	2690
Ether	.37	95	2160
Glycerine	.73	554	———
Oil, cottonseed	.45	———	———
Oil, machine	.37	———	———
Oil, olive	.44	570	———
Paraffin, melted	.64	750	———
Petroleum	.46	———	———
Turpentine	.35	319	2110
Water	1.00	212	17700

(Note: There are 7.48 gals per cubic foot)

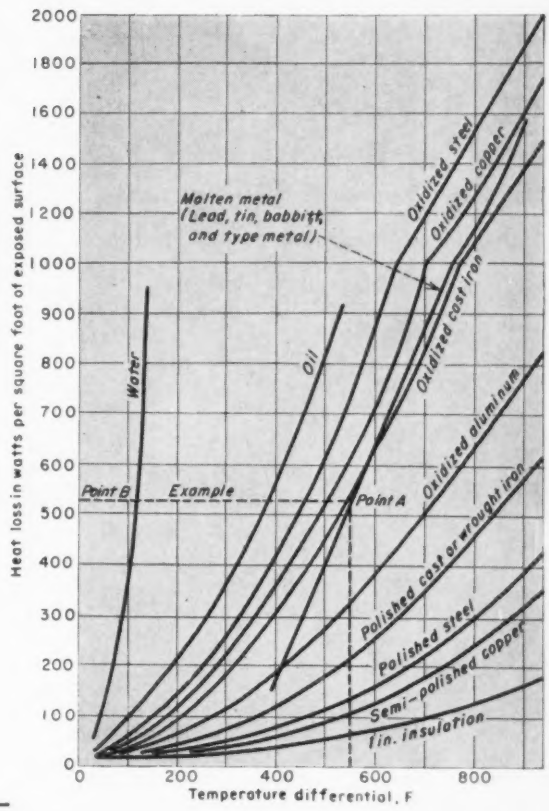
GASES	Basic constant
Acetylene	.41
Air	.30
Ammonia	.40
Carbon dioxide	.40
Carbon monoxide	.30
Chlorine	.40
Hydrochloric acid	.32
Hydrogen	.31
Methane	.43
Nitrogen	.31
Oxygen	.31
Sulfur dioxide	.44

Calculate electric heater wattage this easy way

► IF YOU'RE PLANNING to use electric heaters for some heating job, keep in mind that total wattage required is (1) wattage needed to raise temperature of material from starting temperature to desired temperature (2) wattage required to compensate for loss of heat to surrounding air. Latter depends on material of surface exposed to air and whether surface is vertical or on

and 6 steps to find watts needed to compensate for heat lost to air . . .

1. Determine maximum temperature differential, in degrees F, between material being heated and surrounding air
2. Locate this differential point on bottom scale of graph. Project point vertically until it intersects curve representing material of the exposed surface. From intersection, project point horizontally left to scale of heat loss in watts per square foot of exposed surface
3. Determine area in square feet of *top exposed surface* and multiply by watts per square foot loss. If open container with liquid, use curve for exposed liquid. If solid material or closed container, use curve for top exposed material and multiply by 1.1
4. Determine area in square feet of side or *vertical exposed surfaces* and multiply by watts loss per square foot for that material
5. Determine area in square feet of *bottom exposed surface* and multiply by watts per square foot loss and 0.55
6. Add losses calculated in *3*, *4* and *5* to get total watts required to compensate for heat lost to surrounding air

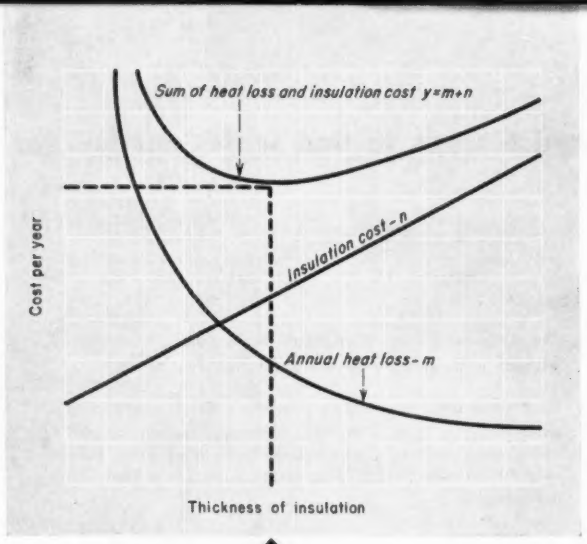


top or bottom, as well as the temperature differential. If you want to melt a solid or vaporize a liquid, you've got to heat material up to melting or vaporizing point, then put in watts to change state. Finally, heat material up to desired temperature above melting or vaporizing temperature. Once material has been heated to desired temperature, it's only necessary to supply wattage equal to losses to maintain temperature. By increasing time to heat material, less wattage is required, but energy (watt-hour) losses go up. Watt losses through one-inch thick insulation are given in graph; for one-half inch insulation multiply by 2, for two-inch insulation divide by 2, etc.

Let's try an example: Melt 300 lb of lead in two hours in a cast-iron pot, 10 in. diameter and 10 in. high, open at top. Follow these steps: (1) 300 lb lead ÷ 710 lb per cu ft = 0.42 cu ft. (2) Locate point on diagonal line above 0.42 cu ft; point *A* in graph on p 90. (3) Temperature rise = melting point of lead minus room temperature = 621 F − 70 F = 551 F. Locate point *B* on right-hand scale. (4) Using straight edge, find point *C* on left scale where basic wattage = 4300. (5) Basic wattage times basic constant = 4300 × 0.35 = 1500 watts. (6) Since lead is to be melted, watts to melt lead must be added. 0.42 cu ft × 7100 watts per cu ft to melt = 2980 watts. Therefore, total wattage to melt lead in one hour = 1500 + 2980 = 4480 watts. (7) Repeat above steps to find watts required to heat container. Estimated weight of container = 50 lb. 50 lb ÷ 450 lb per cu ft = 0.11 cu ft. Temp rise = 551 F. Locating these points and reading basic wattage from left scale gives 1000 watts. Basic watts times basic constant = 1000 × 0.94 = 940 watts. (8) Total watts required to heat materials in one hour = 4480 + 940 = 5420 watts. Since material is to be heated in 2 hr, total wattage = 5420 ÷ 2 = 2710 watts.

Now take a look at losses. (1) Surface temperature = 621 F − 70 F = 551 F temperature differential. (2) For lead, read up from 551 F, on graph above, to molten lead curve, then over to left scale at point *B*. Watts per square foot loss = 530 watts. For cast iron pot, watts per square foot loss = 550 watts. (3) Top exposed surface = 3.14 × 10 = 31.4 sq in. = 31.4 ÷ 144 = 0.218 sq ft. 0.218 × 530 = 116 watts top loss. (4) Side exposed surface = 10 × 3.14 × 10 = 314 sq in. = 314 ÷ 144 = 2.18 sq ft. 2.18 × 550 = 1200 watts side losses. (5) Bottom surface area equals top surface area = 0.218 sq ft. 0.218 × 550 × 0.55 = 66 watts bottom loss. (6) Total watts loss to air = 116 + 1200 + 66 = 1382 watts.

Total wattage equals watts to heat material plus watts loss to air. It's usually advisable to add 10% to final answer and round off number: 2710 + 1380 = 4092 watts. Total watts = 1.1 × 4092 = 4501. Use 4500 watts for job.—*Courtesy of Cutler-Hammer, Inc.*



Concept of cold-surface temperature design can lead to wasteful insulation practice. For maximum dollar savings, use least sum of annual heat loss and insulation cost to . . .

Select economic insulation thickness

By C E ERNST, *Senior Engr, Industrial Insulations Div, Johns Manville Sales Corp*

► USE OF ECONOMICS for selection of insulation thickness is fundamental. Heat energy costs money to produce and insulation must pay its cost out of the heat value it saves. Economic thickness is that which will pay for itself over a given period while producing a specified investment return on its cost. At this thickness the sum of annual cost of heat loss and insulation is a minimum.

Considerable confusion has been caused by general use of the cold-surface temperature concept for selection of insulation thickness on heated equipment and piping. If personnel protection is the sole need, hot- and cold-surface temperatures do control minimum thickness. Enough insulation is then used to keep surface temperature below a maximum of 200 F. But cold-surface temperature is often taken as the sole design criteria. Actually, economics show that even where heat cost is low more insulation is frequently justified than that required by cold-surface temperature.

Table, below, shows that the first inch of insulation thickness saves $2.41 per sq ft in one year. This more than pays its installed cost as normally applied and finished on heated equipment. Since normal insulation does have a long service life, economical thickness is found by using the cost per year over a number of years.

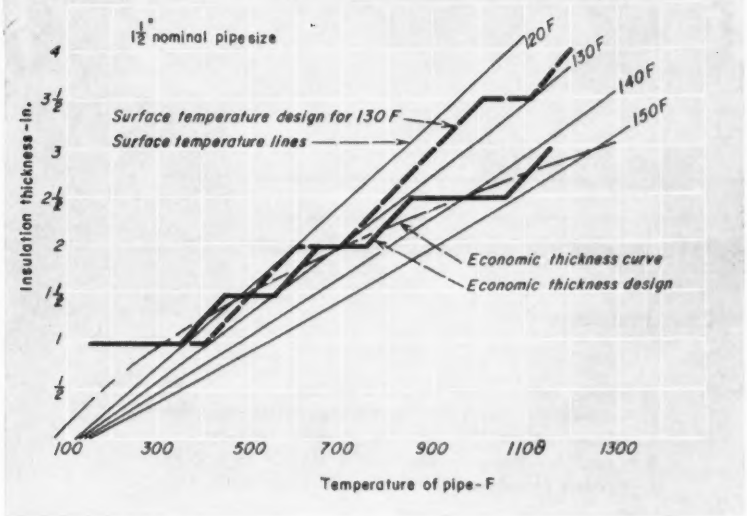
For example, adding ½ in. to the first inch saves an additional $.088 per year, the next ½ in., $.053, and so on. With an amortization period of 10 yrs, approximate yearly applied charge for each added ½ in. thickness of 85% Magnesia is the list value of $0.15 ÷ 10, or $0.015. Therefore the last ½-in. increment that gives enough yearly saving to cover the $0.015 plus return on investment fixes economic thickness. This example was selected for ease of

Dollar value of heat saved by insulation

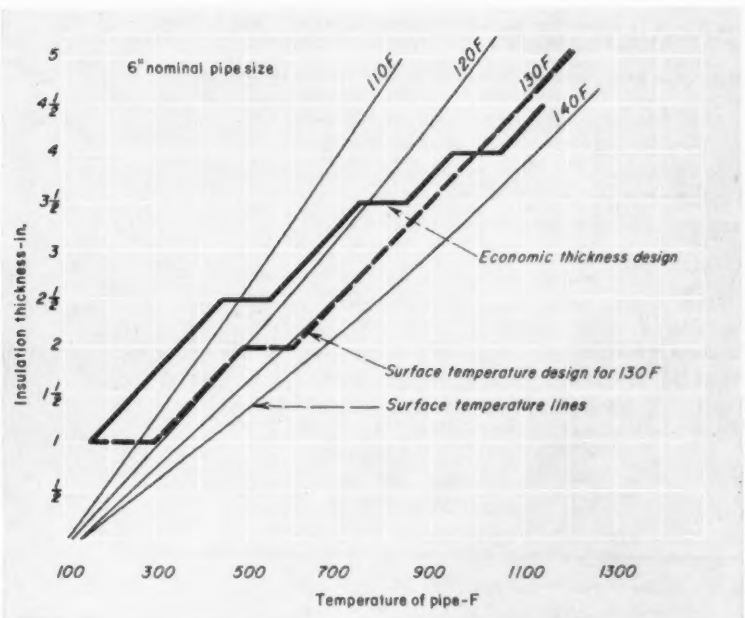
for flat surface at 300 F and 75 F ambient air

Insulation thickness 85% Magnesia	Heat lost	Heat saved	Incremental saving	Heat lost	Heat saved	Incremental saving	Total savings	Incremental saving
	Btu per sq ft per hr			Million Btu per sq ft per year (8760 hr)			Dollars per sq ft at 50c per million Btu	
Bare surface	620	0	0	5.43	0	0	0	0
1"	70	550	550	0.613	4.817	4.817	2.41	2.41
1½"	50	570	20	0.438	4.992	0.175	2.498	0.088
2"	38	582	12	0.333	5.097	0.105	2.551	0.053
2½"	31	589	7	0.272	5.158	0.061	2.582	0.031
3"	26	594	5	0.228	5.202	0.044	2.604	0.022

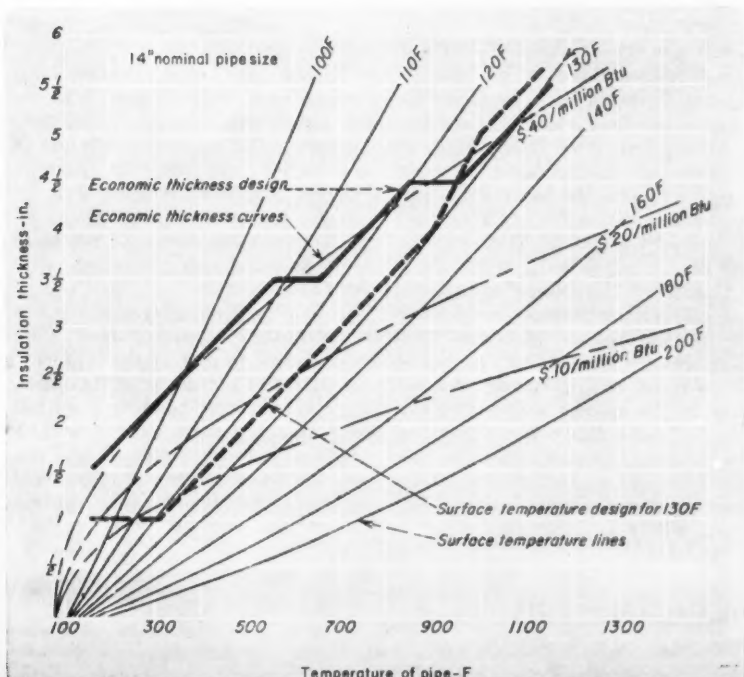
Three charts compare economic and surface temperature thicknesses



1 Family of surface temperature curves illustrate method of selecting surface-temperature thickness. Economic thickness curve shows actual increase of thickness with temperature based on heat at 40c per million Btu. Design thickness for 130-F max surface temperature is also plotted. Both design curves show about the same thickness for 500 F (1½ in). But economic thickness is ¾ in. less than surface temperature thickness at 1100 F.



2 Plot of economic insulation thickness coincides with plot of 130-F cold-surface temperature thickness at 1000 F (4 in.). But economic design justifies more insulation at lower temperatures. Over the range of 300 to 800 F, economic design calls for ½ to ¾ in. more insulation.



3 Economic and cold-surface temperature thicknesses are about even at 950 F (4½ in.). Minimum economic thickness is 1½ in. at 150 F compared to 1 in. for surface temperature. Economic curves are plotted for three heat values. Compare 200-F surface temperature line with economic curve for 10c per million Btu. Economic curve justifies ½ to 1 in. more insulation in range of pipe temperatures from 200 to 1300 F.

Turn page

Here's how to calculate insulation cold-surface temperature

Use equation for heat transmission Q from a flat surface

$$Q = \frac{t_i - t_a}{\frac{L}{k} + \frac{1}{c}}$$

where t_i = inside surface temperature of insulation
t_a = outside air temperature surrounding insulation surface
L = Length of heat flow path; i.e., insulation thickness
k = insulation thermal conductivity in Btu per sq ft F hr.
c = surface conductance in Btu per sq ft F hr.

Note that temperature difference $t_i - t_a$ is across two thermal resistances in series, $\frac{L}{k}$ and $\frac{1}{c}$. Since temperature drop across the insulation is proportional to resistance the cold surface temperature t_{cs} will be:

$$t_{cs} = t_i - \left[\frac{\frac{L}{k}}{\frac{L}{k} + \frac{1}{c}} (t_i - t_a) \right]$$

Example:
t_i = 400 F
t_a = 75 F
L = 2.0 inches
k = 0.5 Btu in. per sq ft F hr
c = 2.0 Btu per sq ft F hr

Solution:

$$t_{cs} = 400 - \left[\frac{\frac{2.0}{0.5}}{\frac{2.0}{0.5} + \frac{1}{2.0}} (400 - 75) \right]$$

$$t_{cs} = 400 - \left[\frac{4}{4.5} \times 325 \right]$$

$$t_{cs} = 400 - 289 = 111 \text{ F (answer)}$$

illustration. In reality, the same result is produced by the minimum sum of yearly cost of heat loss and insulation, based on a fixed charge combining the rate of amortization and the interest on the investment.

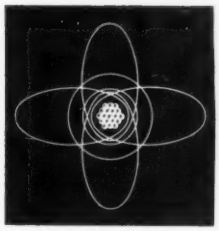
Economic vs surface temperature concept. Economically increasing insulation thickness follows a law of decreasing returns. Each added increment of thickness has less effect on the total heat transfer than any previous increment. Against this progressive decrease in saving is charged an essentially constant cost per added increment. The cold-surface temperature concept completely ignores this fact.

Heat transfer per sq ft from an insulated surface is determined by the temperature difference between that surface and ambient air. Basing insulation thickness on a given surface temperature requires only that heat transfer per sq ft of outer surface be constant for all operating temperatures. It ignores the fact that hot surface may be flat, or a ½- or 30-in. pipe, or heat cost is $.10 or $1.00 per million Btu.

Charts 1, 2 and 3 compare economic and cold-surface temperature thickness for calcium silicate pipe insulation. Economic thicknesses shown are based on heat cost and investment write-off used in the average industrial plant. Charts 1 and 3 have curves illustrating the increase of economic thickness with pipe temperature. Surface temperature lines are shown to point up the differences in these two concepts.

From the cases cited you can see that surface-temperature thickness is not related to economic thickness. And there isn't any valid reason for sole use of cold-surface temperature to select insulation thickness. It appears to be nothing more than an easy method for picking thickness—definitely not based on fundamental principles of heat transfer and economics.

Validity and importance of the economic method is hard to deny. Since heat energy is part of the cost of a manufactured product, or of the operating cost of an office building, it must be kept at a minimum. Only insulation thickness based on economics will provide the lowest yearly sum of heat and insulation cost. It will pay you to take advantage of it.



Nuclear notes

By B G A SKROTZKI, *Associate Editor*

Thud program, thorium-uranium-deuterium, now running in Borax IV uses core made of thoria-urania ceramic pellets submerged in heavy water. Exponential experiments now underway and a zero-power reactor soon ready to run will pave way for trying out such a core in EBWR at Lemont, Ill., late this year.

Controlled Recirculation Boiling Reactor (CRBR) will be built by Allis-Chalmers Mfg Co for Northern States Power Co and nine cooperating midwest utilities to power a 60-mw plant. Cylindrical core, 5x5 ft, will produce 133-mw heat to generate 502,000 lb per hr of 600-psig saturated steam (488 F); 38 mw of oil-fired superheating will raise steam to 1000 F. Special seals on the turbine shaft will seal in the slightly radioactive steam. Large pumps at reactor bottom force reactor water through the core; centrifugal devices separate steam bubbles from the water at top of core. Pioneer Service & Engineering Co are prospective architect-engineers for the project; target date—1962.

AEC offers contracts to reactor owners to chemically process and recover source and special nuclear materials from irradiated fuel elements. Individual negotiations will establish charges for the service, subject to adjustments indicated by an appropriate price index. AEC can cancel contracts one year after giving notice when commercial services become available at reasonable prices. This service includes waste disposal. AEC government-owned plants now are the only ones doing these sorts of operations.

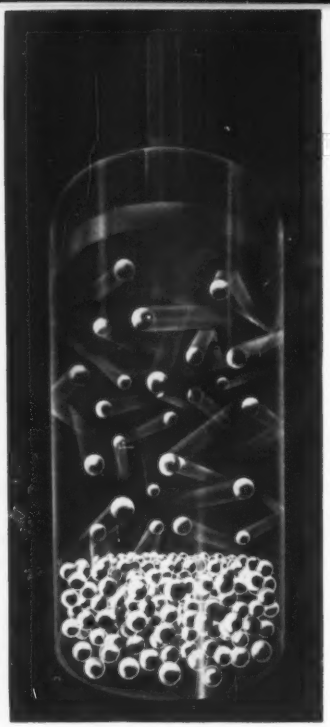
Nearly 60,000 miles traveled in two years by *Nautilus,* first atomic-powered submarine, brings it to its first refueling operation. The first core will be removed this spring and a new one installed. National Reactor Testing Station in Idaho will examine old core to find out how much farther it could have driven sub, and then process it to recover uranium. Some hull plates of *Nautilus* will have to be cut to remove the reactor core. Later subs will have refueling hatch built in.

***Seawolf,* second nuclear sub,** put out to sea on Jan 21 for the first of a series of builder's trials. Corrosion in its liquid-sodium cooling system forced the by-passing of its steam superheater. Reactor system supplies saturated steam to turbine, instead. No reports were made on the effects on efficiency and speed, but preliminary trials "progressed satisfactorily."

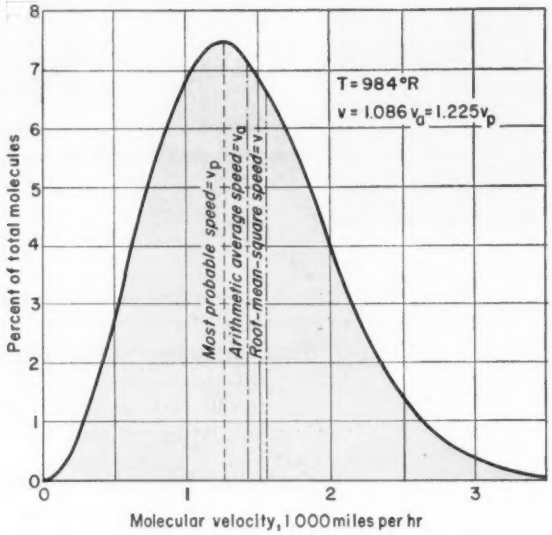
Three atomic submarines, *Skipjack, Triton* and *Skate,* are now under construction at Groton, Conn. *Skipjack* will be world's fastest submarine, *Triton,* to serve as a radar picket station, will be driven by twin reactors and be the world's largest sub. *Skate* will be launched this spring as the third working nuclear sub.

Four more atomic subs are being built at two other locations: *Swordfish* and *Seadragon* at the Portsmouth, N. H., navy yard; and *Sargo* and *Halibut* at the Mare Island, Calif., navy yard.

Sodium Reactor Experiment (SRE) major components have been installed at Santa Susana, Calif., by Atomics International. Southern California Edison has installed the 7.5-mw steam turbine-generator to be powered by the reactor. Some instrumentation and wiring remains to be installed. Calibration, inspection, dry runs and sodium loop testing are now under way.



THERMO REFRESHER NO. 7



1 Molecules in a gas like air have a wide range of speeds at any given temperature; different averages may be used

Thermodynamics keeps track of energy changes in a heat machine by bookkeeping methods. Empirical relations help evaluate energy amounts for use in . . .

By B G A SKROTZKI
Associate Editor

Simple energy equation of gases

► WE DIGRESSED from pure thermo to look at the kinetic molecular theory in Part 6, POWER, Feb 1957, pp 86-89, etc. This gave us some idea of what happens in a gas from a molecular standpoint. We saw that temperature gives us a yardstick of the speed of the molecules bouncing around, since $RT = v^2/3$. R, the gas constant, depends on the mass of the gas molecule, M.

In a gas, absolute temperature T measures the root-mean-square velocity of all the molecules:

$$T \propto v = \sqrt{\frac{v_1^2 + v_2^2 + v_3^2 + \cdots + v_N^2}{N}}$$

Actually we can give a broader meaning to T. Remembering the universal gas constant $MR = R_u = 1545$ (Part 4, Nov 1956, p 93) where M is the molecular weight of the gas, we can write $MRT = Mv^2/3$. Recognizing MR as a constant we see that T depends on Mv^2, the kinetic energy of the molecules.

What does this mean when we compare temperatures of gases with different molecular weights? Just one thing —for equal temperatures heavier gases have slower molecules, since: $T = M_1v_1^2 = M_2v_2^2 = M_3v_3^2 = etc$ Using this formula we'll see that if at 32F, hydrogen molecules move at 3800 miles per hr, oxygen molecules, 16 times heavier, will move at only 950 miles per hr, when they both have the same kinetic energy and temperature.

Perhaps the most interesting fact of molecular motion in a gas is the wide range of speeds they have at a given temperature, Fig. 11 (Part 6, Feb 1957, p 69); Fig. 1 reproduces the distribution curve for air at 984 °R (524 F). Remember, the absolute temperature measures one particular kind of average, the *root-mean-square* defined above, v. Fig. 1 shows that for 984-°R air, the largest single group of molecules (about 7.5%) have a speed called the *most probable*, v_p. We could also figure the *arithmetical average speed*, v_a. These three measures of the collective speed of a group of molecules are definitely related:

$$v = 1.086\ v_a = 1.225\ v_p$$

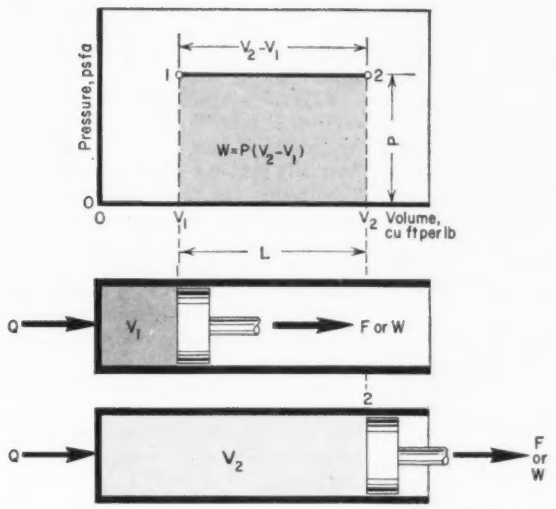
So much for the kinetic theory, let's now return to our energy equations.

Energy conversion. We had our first hint on how to change heat energy into mechanical shaft energy in Part 5, Jan 1957, pp 98-99. Let's review. Fig. 2 shows the constant-pressure heating of one pound of gas trapped behind a leak-proof frictionless piston in a cylinder. The gas exerts a constant force F on the piston while it moves from from *1* to *2*, and absorbs a heat input Q. Here we have energy entering as heat at one end of the cylinder and energy leaving as mechanical shaft work at the other, a heat engine.

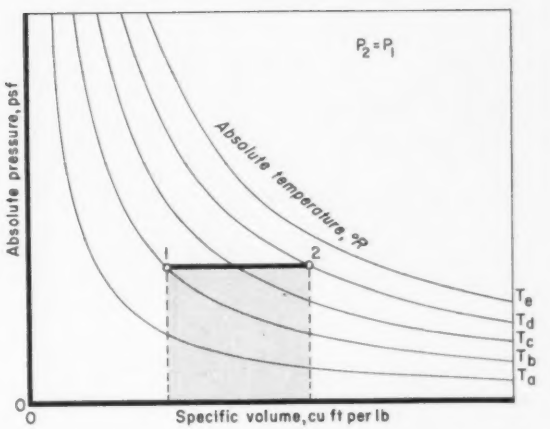
The work done by the gas on the piston is

$$W = F \times L \qquad \text{but}$$
$$F = P \times A$$

where P is the gas pressure in psfa, A is the cross-sectional area of the piston in sq ft, and W is the work in ft-lb.



2 In constant-pressure process, gas takes in heat Q while it does mechanical work on piston during the expansion



3 Constant-pressure expansion, 1-2, or compression, 2-1, always involves a change in the temperature of the gas

Substituting for F we get

$$W = P \times A \times L$$

but Fig. 2 shows that

$$A \times L = V_2 - V_1 \qquad \text{so}$$

$$W = P(V_2 - V_1)$$

Plotting this change in pressure and volume for the 1 lb of gas, we get the horizontal line shown in the graph of Fig. 2. From the equation for W we see that the area under the pressure line also measures the value of W.

We find the *P-V* graph a useful tool to analyze what takes place in converting all or part of heat energy Q into useful shaft work W. Examining the *P-V* graph, we find the gas was first in state *1* and then expanded at constant pressure to state *2*. For *ideal* conditions the area W under the process curve always measures the amount of mechanical work W done by the gas on the moving piston, or vice versa.

What happened to the gas temperature in changing from state *1* to state *2*? Since the mass of gas stays constant, there are always the same number of molecules trapped in the cylinder. Allowing the volume to increase means there would be fewer hits per second on the piston causing a drop in pressure. But since the pressure stayed constant with increasing volume, it means that the added heat energy Q sped up the molecules so they kept making the same number of hits per second, even though they had greater average distances to travel. This means that the gas temperature at state *2* is higher than at *1*.

According to the first law of thermodynamics we should be able to account for all energy entering or leaving the gas during the process. From the simple analysis we made we see that heat Q went partly to raising the internal energy of the gas from E_1 to E_2, and the remainder went to produce mechanical work W.

Reversibility. If we can control all heat flows into and out of the gas at will, and there is no friction between piston and cylinder, and the gas can contract or expand smoothly without setting up any vortices or pressure waves inside itself, we will achieve an ideal condition for making energy conversions. Most thermodynamic calculations assume such a condition exists.

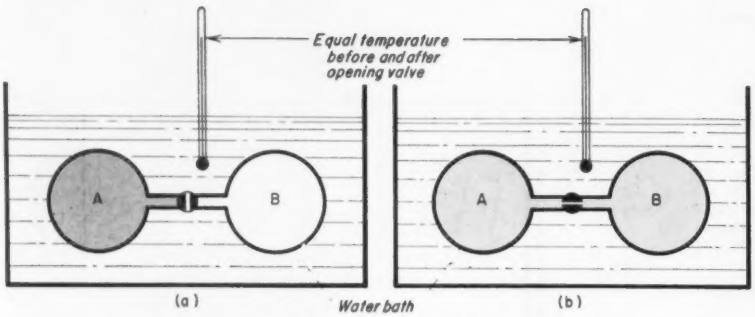
When this is true, we can reverse the force F in Fig. 2 and have it compress the gas from V_2 to V_1 and eject heat Q. In this case W would be the work done *on* the gas *by* the piston. The temperature would also drop from the higher T_2 to the lower T_1. The ability to do this exactly is called *reversibility*. The first process, then, is a reversible constant-pressure expansion and the second a reversible constant-pressure compression. These are only theoretically possible—ideals; actually we can't attain them.

General gas equation. When we have a gas confined as in Fig. 1, don't forget that the general gas equation always applies, $PV = RT$. If we know two of the properties, P, V or T at any state we can always figure the third, assuming we know what kind of gas we have. For all *reversible processes* the area under the process line on a *P-V* graph represents the mechanical work done (in ft-lb) on or by the gas.

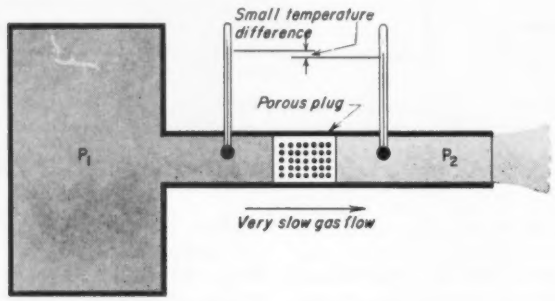
Before we go further, let's refresh our memory about Fig. 4 of Part 3 (Oct 1956, p 101) showing the plot of the general gas equation for air at constant temperatures over a range of 100 to 1500 °R. To change the state of a gas we have to inject or remove energy either as work or heat. Fig. 3 shows the same general relation (without numbers) of P, V and T of a perfect gas, as a general counterpart of Fig. 4—Part 3. The constant-pressure process *1*—*2* plotted on Fig. 3 shows that a change of temperature must be involved. The shaded area underneath represents the work that must be done to compress the gas from *2* to *1*, or the work output realized when expanding the gas from *1* to *2*.

Joule's experiment. To show that the internal energy of a gas is essentially independent of pressure and specific volume, Joule did his famous experiment. The equipment was relatively simple. He took two vessels and connected them through a pipe carrying a closed shutoff valve. One vessel was evacuated to remove practically all air. The other vessel was charged with air to any convenient pressure. He then placed both vessels in a water bath and waited long enough to insure that vessels, entrapped air and the water bath were all at the same temperature, Fig. 4.

He then opened the valve letting air from the pressurized vessel flow freely into the empty one until the pressure was equal in each. Closely watching the thermometer he found no change in temperature. Even though the air doubled its original volume and halved



4 Joule's simple experiment of allowing gas to double its volume showed its temperature was not affected by change



5 Gas at high pressure P_1 seeping through porous plug to low pressure P_2 shows slight drop in temperature at P_2

its pressure, its temperature stayed constant. While some of the gas molecules moved into additional space, they did no mechanical work; neither did they receive or give up heat energy. So the molecules retained their original kinetic energy as shown by the constant temperature.

This rather coarse experiment developed the principle of independence of the temperature of a gas from its pressure and density. This idea is practical enough in most engineering machines.

Later experiments of different form showed this to be not strictly true. Actually, there is a slight mutual force of attraction between the fast-moving molecules of a gas. When the gas expands to greatly increase its volume, the molecules move farther apart on the average.

This means they do mechanical work against their mutual forces of attraction in filling the larger volume. This slows them down. They simply redistribute the energy they have, exchanging a small part of their kinetic energy for potential mechanical energy, Part 1, Aug 1956, pp 98-102. This causes a small drop in temperature. Remember, temperature measures only kinetic energy, not potential energy of molecules.

This effect only becomes important at high pressures. It's detected by the porous-plug experiment of Joule-Thomson, Fig. 5. Here high-pressure gas flows very slowly through a porous ceramic plug with many small holes to a lower pressure. Precise temperature measurements show small changes at the higher pressures. These effects are taken into account in designing h-p engines.

System. Let's get back to the gas in our cylinder and piston and put down what we've learned in more formal style. The gas in an ideal cylinder and piston may be called a closed system. Energy changes in this system ideally take place in only three ways: (1) heat in or out Q (2) work in or out W (3) gain or loss of internal energy E. Then according to the first law:

$$Q = (E_2 - E_1) + W$$

This is the *simple energy equation* also called the *non-flow energy equation*. Q and W are not properties of the gas but forms of energy in transit. On the other hand E is a property of the gas directly related to T. We must be careful on interpreting the signs in this equation. We will arbitrarily assume that energy Q entering the gas will be plus and that work done by the gas W (energy leaving) will also be plus. When Q and W reverse their direction their signs become minus.

When W is figured from P and V the result is in ft-lb. We convert this to Btu by dividing W by $J = 778$ ft-lb per Btu. Normally Q and E are given in Btu.

Note that the energy equation does its computation by a bookkeeping or accounting procedure. It makes no pretense of *explaining* just *how* energy converts from one form to another. If we accept the first law, then the energy changes must balance according to the basic equation.

Constant pressure process. We already discussed this process in detail, Fig. 2 and 3. But let's analyze it according to the simple energy equation:

$$Q = (E_2 - E_1) + W \qquad (1)$$

$$Q = c_v (T_2 - T_1) + P_1 (V_2 - V_1)/J \qquad (2)$$

The Joule experiment showed that internal energy depended only on temperature. We anticipated this in Part 5, Jan 1957, p 99, where we learned that change in E can be figured by the constant-volume specific heat c_v, as in equation (2) above.

Plotting this process on P-V graph, Fig. 3, we note that a considerable change in temperature must take place, so for expansion the gas stores internal energy, for compression it gives up internal energy.

Let's rewrite equation (2) remembering that $P_1 = P_2$:

$$Q = E_2 - E_1 + (P_2V_2 - P_1V_1)/J$$

$$Q = (E_2 + P_2V_2/J) - (E_1 + P_1V_1/J) \qquad (3)$$

The quantity $(E + PV/J)$ appears so often in thermodynamics that it is given a special symbol H and the name *enthalpy*. This combination quantity appears in both the gas tables and steam tables—it is mostly a symbol of convenience rather than physical significance. Because of this we can now rewrite (3) as:

$$Q = H_2 - H_1 \qquad (4)$$

By definition, let's not forget that for the constant-pressure process:

$$Q = c_p (T_2 - T_1) \qquad (5)$$

Then we come to an important relation by combining (4) and (5):

$$H_2 - H_1 = c_p (T_2 - T_1) \qquad (6)$$

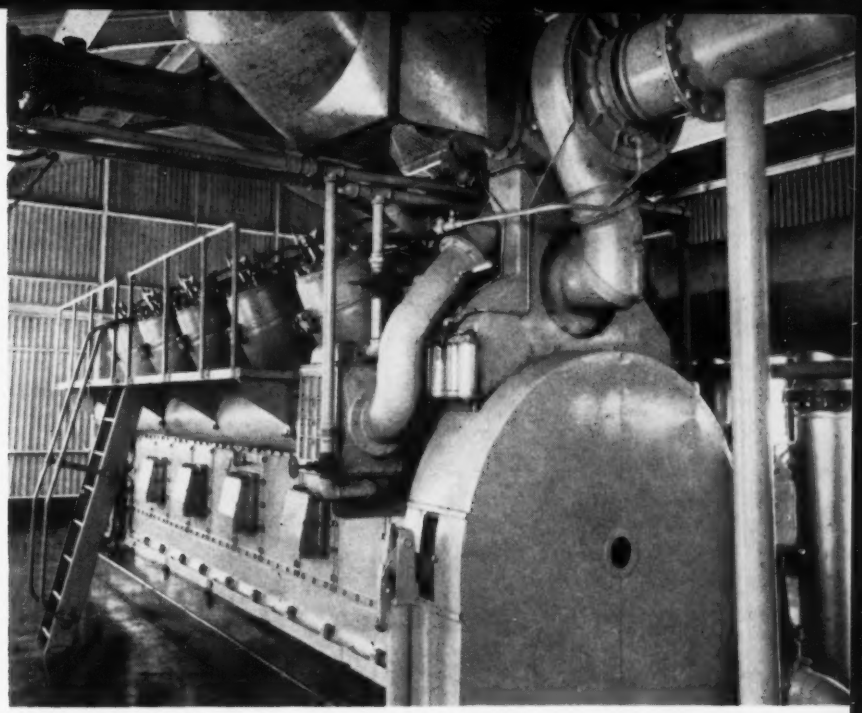
Don't forget that these equations are all exact for reversible processes. Equation (6) holds for all perfect gases since H is a combination property of a gas. Before we leave these equations note that:

$\Delta E = c_v \Delta T$ and

$\Delta H = c_p \Delta T$

where Δ (delta) refers to change or difference in a property during a process.

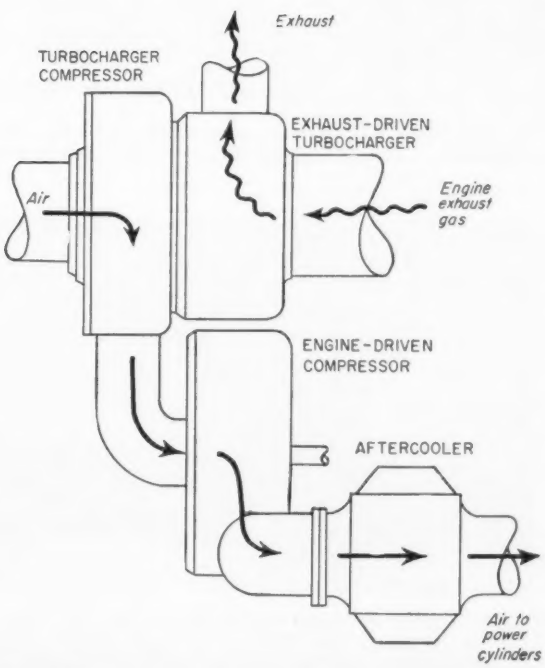
Next part will deal with more energy equations for perfect gases—in a forthcoming issue.



SERIES TURBOCHARGED engine-compressor at Magnolia Petroleum's Pegasus Station

From start through the load range, high performance is obtained by teaming exhaust and mechanical blowers in . . .

Series turbocharging for 2-cycle engines



SERIES UNIT includes exhaust- and engine-driven compressors

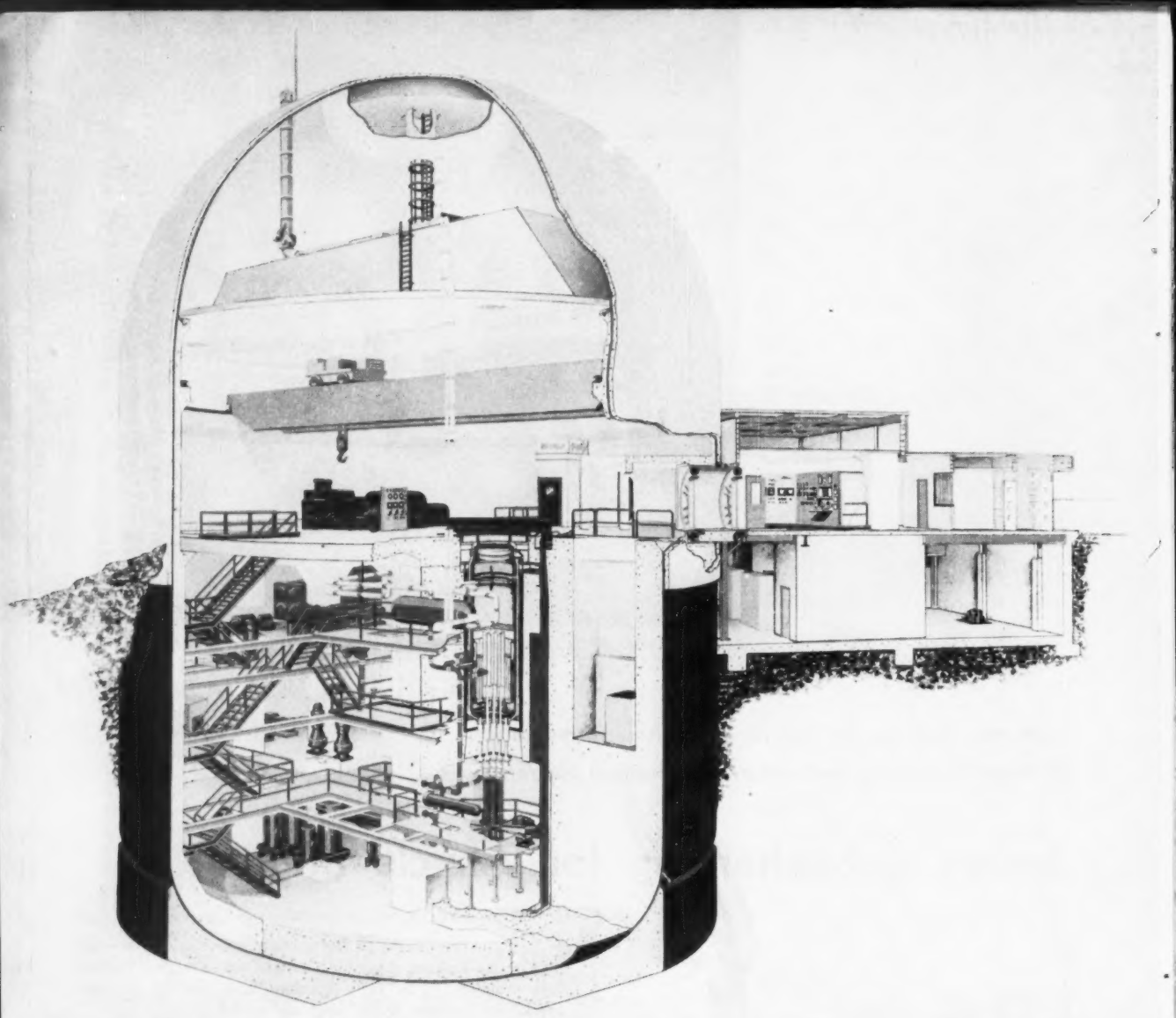
► THE 2-CYCLE ENGINE in the photo above is one of several in pipeline stations employing a new turbocharging system that promises to be fully effective from startup through partial load ranges to full load and speed.

2-cycle problem. The inherent difficulty in turbocharging 2-cycle engines lies in the fact that, in addition to combustion air, a more or less constant amount of scavenging air must also be supplied. When this scavenging air requirement is high in proportion to the total, as at low loads and speeds, the compressor power requirement is high in relation to the exhaust energy available.

Supercharging for the 2-cycle engine can be accomplished in several ways. The job can be done, for example, with a centrifugal blower driven from the engine. Or a turbocharger can be used, geared to the engine during startup and light loads and disengaged when exhaust energy is fully adequate to meet compressor power needs. Finally, by extremely careful design, an independent turbocharger may be used.

Series system. Now, Cooper-Bessemer engineers have combined the all-exhaust turbocharger with the mechanically driven blower to obtain the inherent advantages of the two systems. This series arrangement yields ability to be completely self-starting and to sustain operation under partial load conditions, without mechanical devices to disengage after the engine starts up.

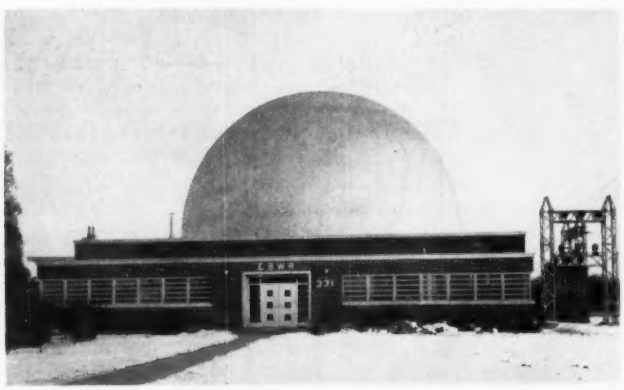
As diagram, left, shows, intake air for scavenging and combustion is compressed first in a turbocharger and then in a mechanically driven blower. Aftercooler reduces air temperature before it enters the (*Continued on page* 226)



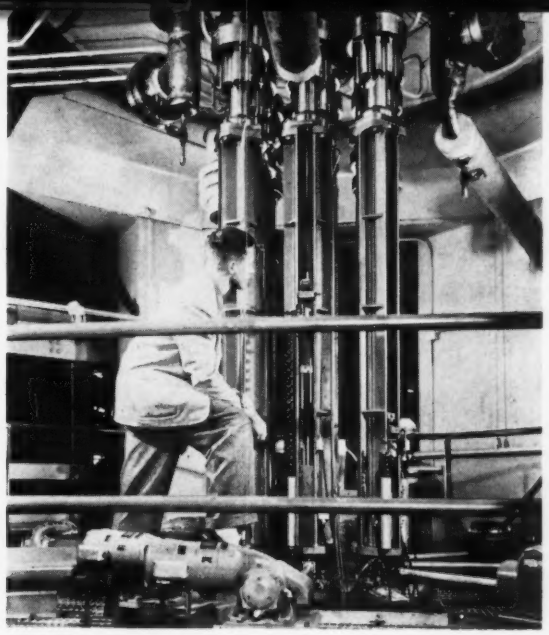
EXPERIMENTAL BOILING WATER REACTOR has entire power plant housed in 80-ft dia steel shell with concrete liner. Reactor vessel cover stands flush with turbine operating floor; irradiated-fuel storage tank located at the right side in shell

Argonne's EBWR goes on the line

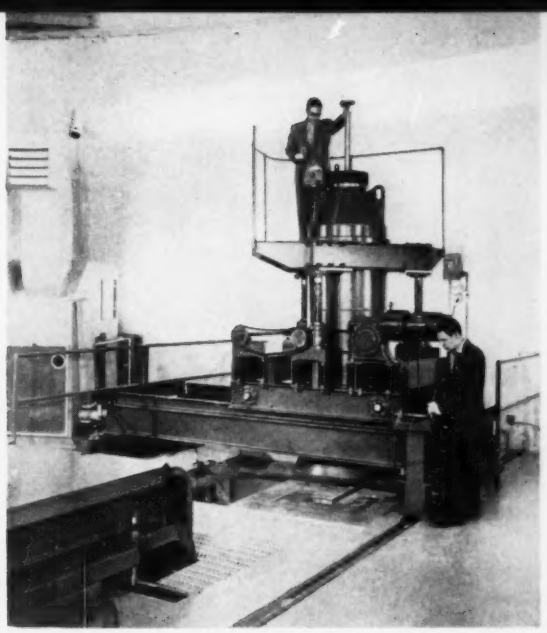
On December 21, 1956, Experimental Boiling Water Reactor (EBWR) first went critical. On December 28 it first produced 20-mw heat and the next day it first generated 5-mw electric rated load



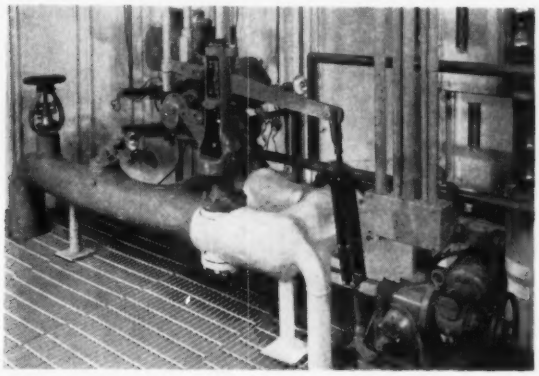
EBWR SERVICE BUILDING houses control room for remote operation of plant. Plant first went on line Feb 9 to supply electric power to Argonne National Laboratory, Lemont, Ill, about 30 miles southwest of central Chicago loop area



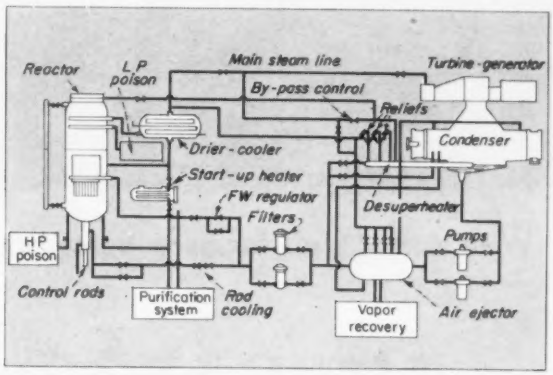
CONTROL-ROD DRIVES for boiling-water reactor handle total of nine rods entering core from bottom of reactor vessel, see cross section opposite page. Interlock system can shut down reactor if one out of 15 operating conditions becomes unsafe



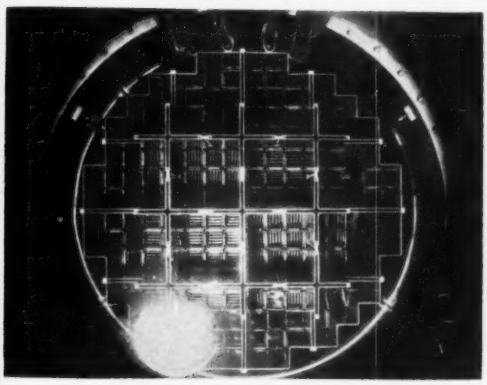
HEAVY LEAD COFFIN riding on rails removes radioactive fuel rods from reactor, *left*, carries them to and delivers them into water-filled decay storage tank standing under coffin in position shown, see diagram on the opposite page for locations



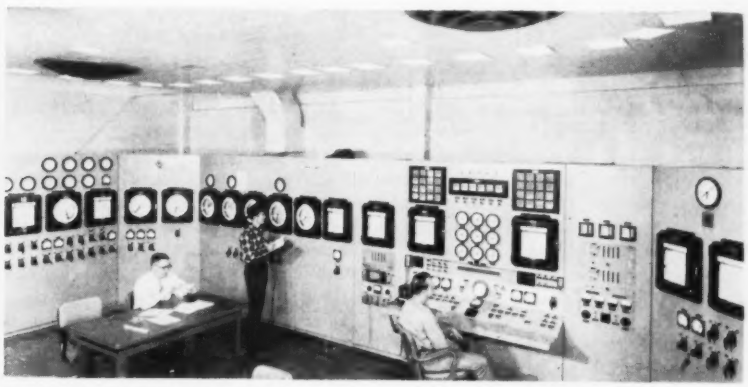
FEEDWATER REGULATING VALVE controls water flow into reactor. Lights and television camera, *upper left*, transmit reactor water-gage readings, showing reactor water level, into control room for remote operation. Meters are also used



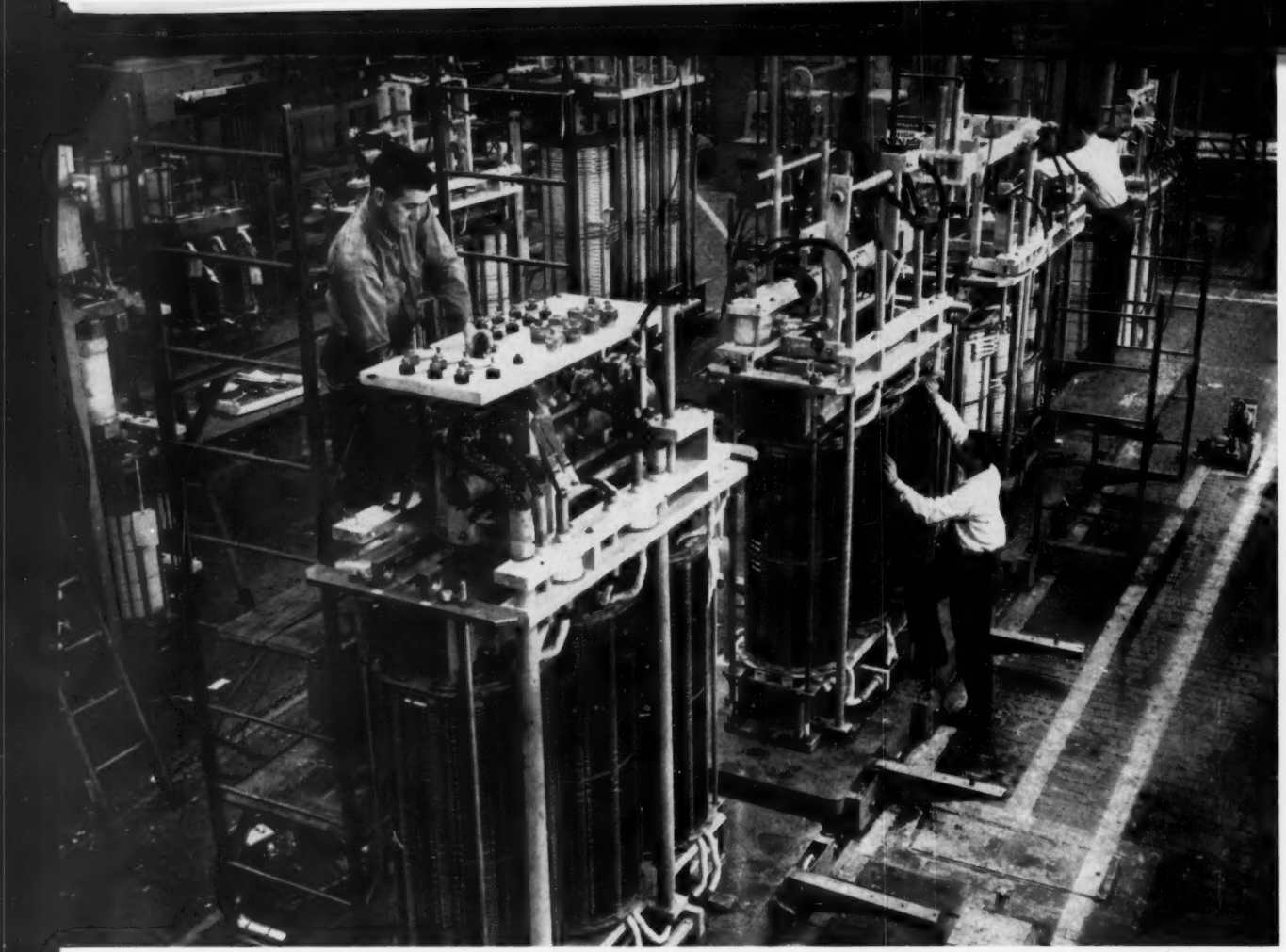
EBWR GENERATING PLANT uses straight condensing cycle, features automatically controlled steam by-pass around 5-mw turbine that discharges to desuperheater and main condenser. Poisons shut down reactor in an extreme plant emergency



REACTOR CORE LOADING shown here just makes unit critical. Water circulates upward through coolant channels between enriched-uranium fuel plates



CONTROL ROOM FOR EBWR carries on and supervises all operations remotely. Instruments in this room connect to power equipment through 1200 electric cables that pass through gas-tight ports in containment shell. Reactor will operate at constant power level; turbine load variation is met by altering by-passed steam



With some transformers being assembled in production-line fashion . . .

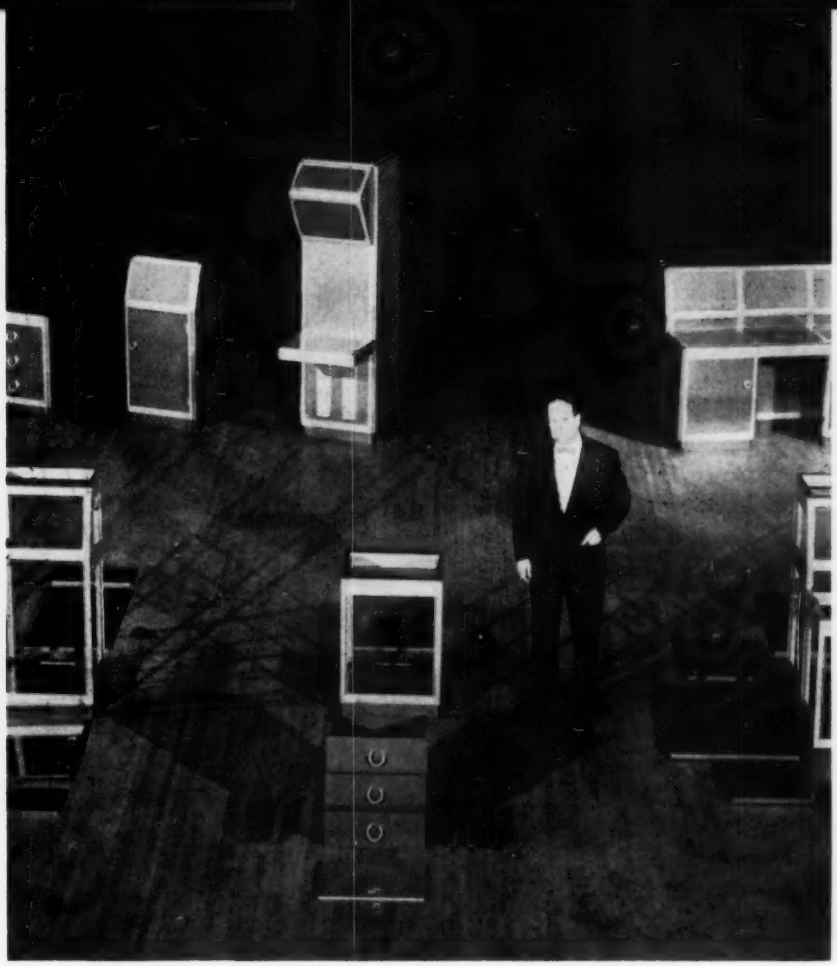
More mass production of electrical

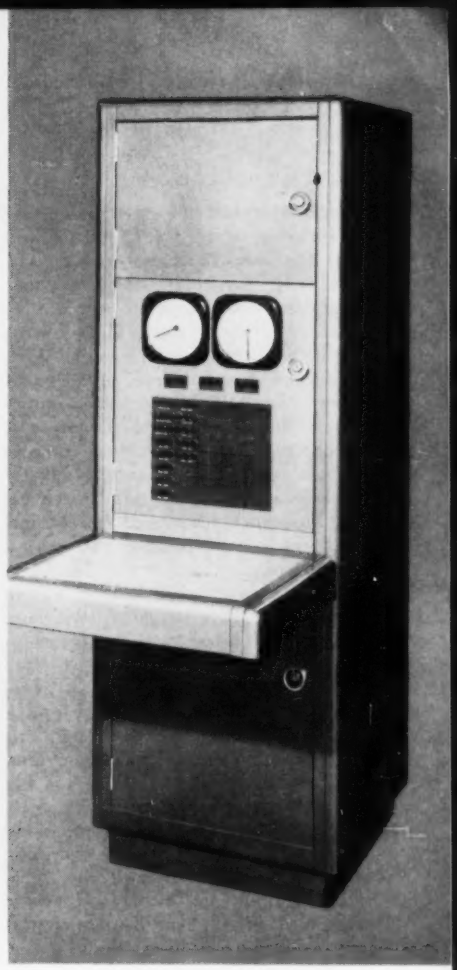
► PRODUCTION of electrical equipment and goods in the United States has established a pattern of doubling every ten years. There is every reason to believe this pattern will continue in the next decade and may well accelerate. In fàce of this growth, electrical manufacturers are seeking some practical answers to, what they believe are, most serious questions. Will they be required to double their investment in production facilities over the next ten years? *Can* they double their technical staff?

Mass-production of key electrical equipment, rather than the continuing use of "specials" is the answer being proposed on several fronts. D B Lawton, general manager of GE's medium transformer dept in Rome, Georgia, recently took a stand using his products (medium size transformers) as a case in point. His thesis: Mass production rests upon standardization of the product. When total production—split among many customers—is small, no real effort toward standardization is required. Under these circumstances seldom will a high-quality low-cost product result. There just isn't any demand for other than custom-built equipment. But as demand increases standardization starts. Eventually, if volume warrants, the era of low-cost top-quality mass production begins. This was the path followed, evolution-wise, in the manufacture of automobiles, airplanes, clothing, guns, tractors.

Modular cabinet system, to meet the growing demands in the control industry, is proposing a similar approach to the same basic problem. Recognizing this need, S K Frankel, president of the Elgin Metalformers Corp, set out to fulfill a 4-part program: (1) Produce a cabinet system flexible enough to meet continual modifications in equipment design (2) Standardize for fast production (3) Build a cabinet which equals custom-made standards in performance and appearance (4) The final product to cost anywhere from 1/3 to ½ below that for custom-built units.

Medium transformers, as defined by GE's Lawton, include all units up to 69 kv, 501 to 10,000 kva. In 1957, between 200 and 250 million dollars will be spent for medium and large power transformers. This sum will buy 1500





and mass-produced modular cabinets now on tap for control industry . . .

gear promises to hold the cost line

to 2000 large units and 4000 to 5000 medium transformers. By 1966 the country will be installing medium transformers at the rate of 200 a week. Availability and cost of those transformers in 1966 depends upon how well mass production techniques are adopted.

Custom-built or special units have their place. Certain needs will always arise calling for special treatment. In such cases a special is justified and will carry a higher price tag since the real benefits of mass production go to those who buy the mass produced units. Today, production volume in the medium size transformer is far beyond the bounds of custom building, posing an opportunity for real standardization.

First steps toward that goal have been taken in the form of NEMA-ASA standards. Lawton quotes an 8% price differential between a standard and special transformer. This price difference has accounted for an estimated $20 million savings for transformer users solely because of lower engineering content and manufacturing savings inherent in the standard unit. Savings of twice the $20 million figure are certain in the next ten years. But many times this figure is possble if there is a wider adoption of truly standard transformers.

Under the NEMA standards, so many options are allowed that literally thousands of different units can be listed as standard. According to Lawton, present standards have but scratched the surface of a rich vein that waits for exploitation to benefit customer, manufacturer, and general public. The multitude of options included in the 1948 ASA Standards were, in Lawton's opinion, included only to get agreement between transformer makers.

No real volume in transformers existed prior to World War II. So during the first 40 years of this century, users established the habit of buying custom-made units. In many cases they established their own engineering departments which, in effect, designed or modified the maker's design of the transformers they wanted. And these designs or modifications varied from one utility to another. Reason might be inherent system differences or simply because there is always more than one way to skin a cat. Naturally, each en-

gineer exercised his own preferences.

However, since many electric utilities and industrial users grow up with ther own particular system voltages, complete standardization will not be realized for many years. Heavy investments in present equipment must remain and, in some cases, be added to. True, the utility distribution transformer has reached a high degree of standardization and today can be bought off-the-shelf. Lawton feels the time is ripe to push this degree upstream, into the confused middle area that lies between the user and generator. Depending upon the degree to which this is accomplished, we will in the long run have higher or lower costs for the added electrical equipment to handle future growth.

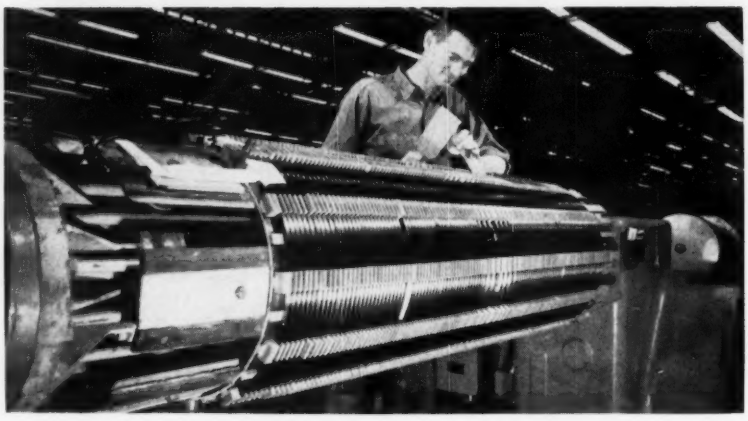
Modular cabinets for the fast growing control field, may appear a far cry from medium size transformers. But both have a common undertone. The cabinet bottleneck has been a toughie for design engineers in many areas. Research and development programs have followed, in many cases, a growth pattern like the proverbial Topsy. Temporary test equipment often becomes a permanent installation. More often, the original equipment is modified in size over the span of a few months. A truly flexible cabinet system provides the solution.

The thinking behind Elgin's move is anything but new. Their system is an engineer's erector set composed of subparts, prefabricated by assembly line methods. By withdrawing parts from stock, finished cabinets in many sizes, shapes and models can be constructed by screwing together different tops, backs, sides, and fronts to the basic modular steel framework skeletons. Forty different panel types and four different size drawers make up the component parts which can be fastened to the frames.

This means a design engineer, laying out a complete control arrangement, can select from 75 building-block metal cabinet enclosures and can work with 125 different sub-parts from the catalog to order the cabinet he needs. Starting with a basic unit, frames may be bolted together side-by-side, front-to-back. They can be stacked on one another.

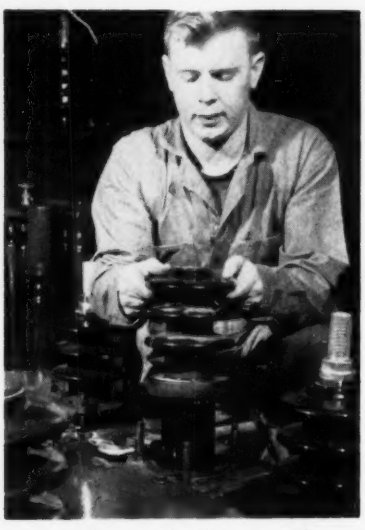
Standardization on product has spelled out some tangible benefits for the Elgin Co. *Example:* Today they produce as much in two days as they did during the entire month of October 1954. Elgin officials report that a standard line of modular cabinets will satisy 75% of industry's needs.

Typical steps in streamlined transformer building



From adjusting transformer coil on winding machine to . . .

Teamwork on bolt clamping



. . . and easy bushing makeup

GE's assembly winds up with true production line testing

Number of schedule 40 steel pipe this size

1/8	1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	6	8	10	12	14	16	18	20	
7060	3860	2105	1320	755	465	269	198	120	84	54	31	14	8	5.1	3.6	3.0	2.3	1.8	1.4	24
4900	2160	1455	915	522	322	186	137	83	58	37	22	9.6	5.5	3.5	2.5	2.0	1.6	1.2	20	
3940	2145	1170	735	420	259	149	110	67	47	30	17	7.7	4.5	2.9	2.0	1.6	1.3	18		
3110	1700	925	580	332	204	118	87	53	37	24	14	6.1	3.5	2.2	1.6	1.3	16			
2380	1300	710	445	254	157	90	66	40	28	18	11	4.7	2.7	1.7	1.2	14				
1970	1075	586	368	210	130	75	55	33	23	15	8.8	3.9	2.2	1.4	12					
1390	760	413	260	148	91	53	39	23	16	10	6.2	2.7	1.6	10						
880	480	262	165	94	58	33	25	15	10	6.7	3.9	1.7	8							
508	277	151	95	54	33	19	14	8.6	6	3.9	2.3	6								
224	122	67	42	24	15	8.5	6.2	2.8	2.6	1.7	4									
130	71	39	24	14	8.5	4.9	3.6	2.2	1.5	3										
84	46	25	16	9	5.5	3.2	2.4	1.4	2 1/2											
59	32	17	11	6.3	3.9	2.2	1.6	2												
36	19	11	6.7	3.8	2.3	1.4	1 1/2													
26	14	7.8	4.9	2.8	1.7	1 1/4														
15	8.3	4.5	2.8	1.6	1															
9.4	5.1	2.8	1.7	3/4																
5.3	2.2	1.6	1/2																	
3.3	1.8	3/8																		
1.8	1/4																			

Equivalent in cross sectional internal area to one pipe this size

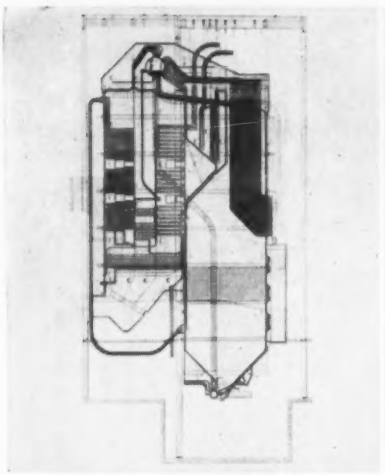
Equal internal cross sections for schedule-40 piping

► THIS TABLE SHOWS how many pipes of a smaller nominal outside diameter are needed to get the same internal cross section of a single larger pipe. Smaller-diameter pipes are listed at top of table. larger-diameter pipes on the bottom diagonal.

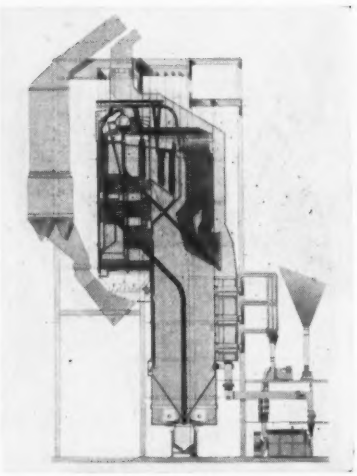
Let's examine the table for 2-in. piping: It shows that 120 2-in. pipes have the same cross section as one 24-in. pipe; 83 2-in. pipes the same as one 20-in. pipe; 67 2-in. pipes same as one 18-in. pipe, etc. These pairs have the same capacity at equal fluid velocities, but the pressure drops will be considerably different. being higher for the smaller pipes.

K M HOLADAY, *Webster Groves, Mo.*

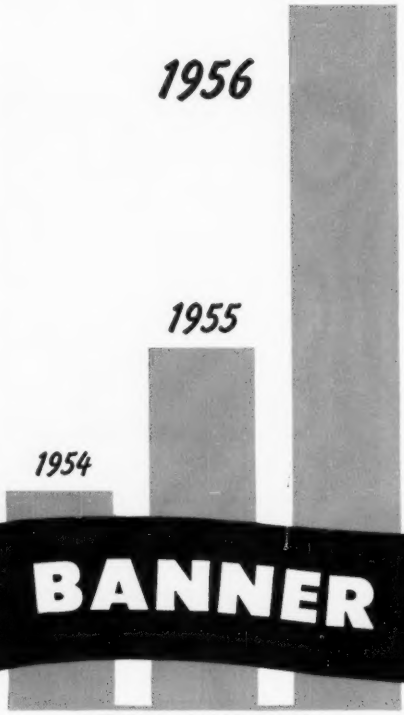
© POWER



600,000#, 1700 psi., 1000 F. Reheat

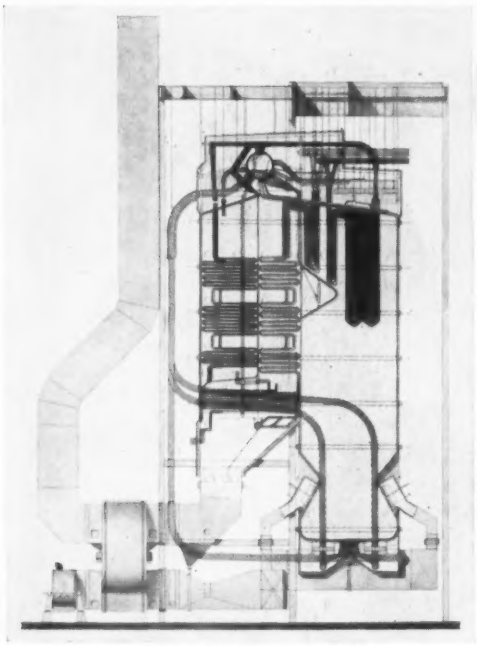


1,000,000#, 2075 psi., 1005 F. Reheat



COMPARATIVE YEARLY BOILER SALES

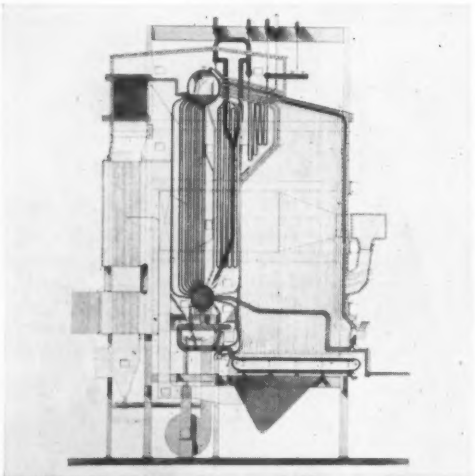
1956 BANNER



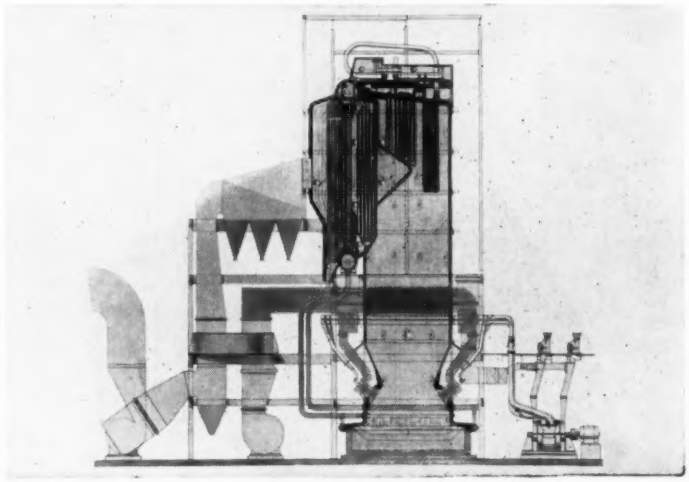
1,550,000#, 2125 psi., 1005 F. Reheat
TURBO FURNACE

1956 sales of Riley central station and large industrial type boilers were the highest in Riley history. Contributing to this outstanding sales record is the unusual acceptance of the comparatively new Riley TURBO FURNACE, a unique design that provides solutions to a number of problems associated with the economics of fuel utilization.

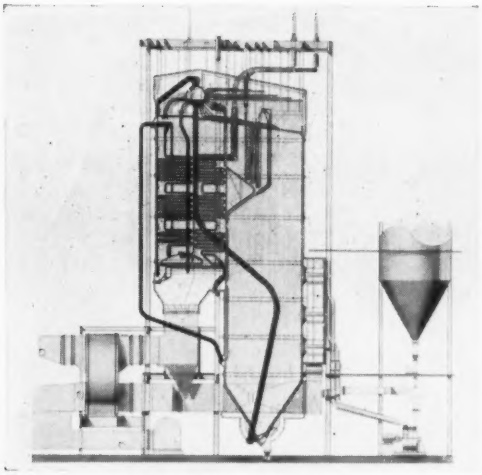
A large percentage of Riley's 1956 sales was to former customers that are completely satisfied with the continuity of operation, high rates of efficiency and dependability of Riley units purchased in the past. One prominent chemical producer ordered ten large boilers from Riley bringing its total number of Riley



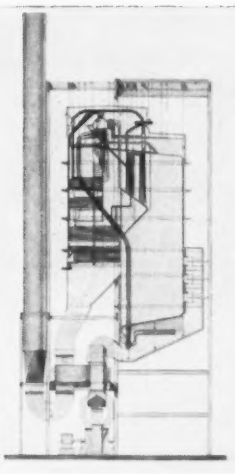
250,000#, 1025 psi., 905 F.



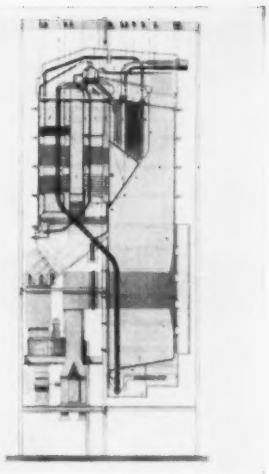
500,000#, 1425 psi., 950 F.



500,000#, 1725 psi., 1005 F. Reheat

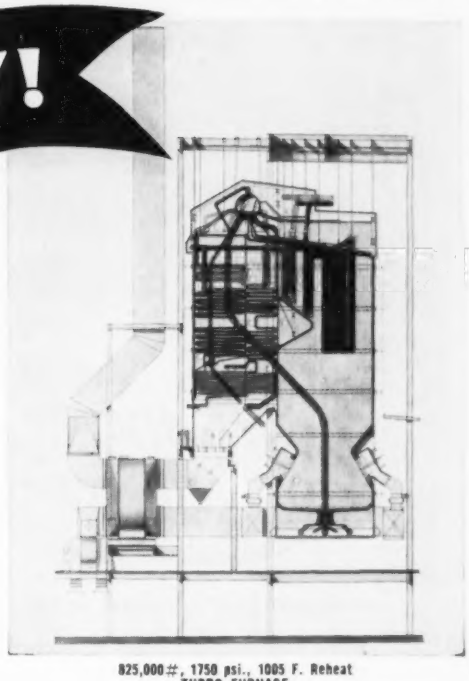


1,050,000#, 1725 psi., 1005 F.



1,290,000#, 2125 psi., 1005 F. Reheat

YEAR FOR RILEY!



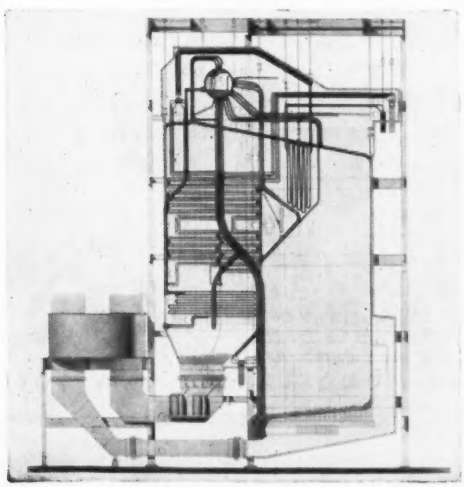
825,000#, 1750 psi., 1005 F. Reheat
TURBO FURNACE

units to thirty-six, with a total steam generating capacity of 12,775,000 pounds per hour.

Most Riley units sold in 1956 include Riley Fuel Burning Equipment: Flare Type Burners, Riley Directional Flame Burners (with TURBO FURNACE units), Riley Intertube Gas/Oil Burners, Riley Pulverizers, Riley Spreader Stokers with Traveling Grates or with new Riley Oscillating Grates.

With today's fuel economics playing such a vital role in the selection of your steam generating equipment, you can rely on Riley for the solution to virtually any conceivable fuel situation.

Illustrations depict typical designs of Riley Central Station Units.



350,000#, 1650 psi., 1005 F. Reheat

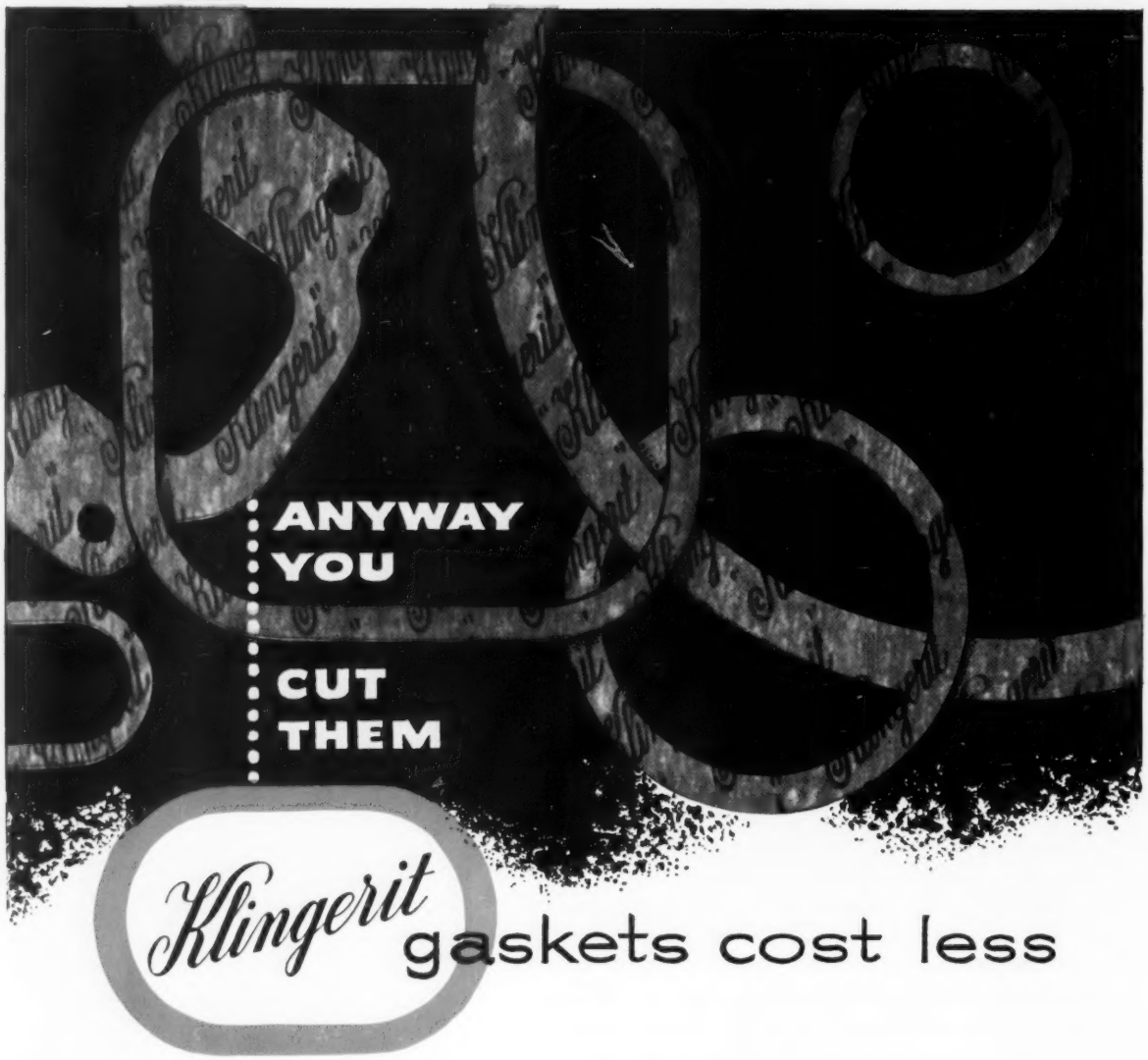
A survey of your plant by a consulting engineer could show ways of making surprising savings in your power costs.

RILEY

Stoker Corporation

WORCESTER, MASSACHUSETTS

Sales Offices: Worcester, New York, Philadelphia, Buffalo, Pittsburgh, Cleveland, Detroit, Chicago, Cincinnati, Charlotte, New Orleans, Atlanta, St. Louis, Kansas City, St. Paul, Houston, Denver (Englewood), Salt Lake City, Los Angeles, San Francisco, Portland, Seattle.



Klingerit gaskets cost less

Whether you use sheet or ready cut gaskets — Klingerit Gaskets cost *less* . . . because they last longer. Recommended for high temperatures, pressure joints in Refineries and Chemical Plants, Klingerit Gaskets practically eliminate costly joint failures. Available in thicknesses of .008″ to ¼″ in sheet sizes 60″ x 160″ from many convenient sources.

"Klingerit" — Universally used sheet packing for super-heated and saturated steam, hydraulic pressures, compressed air, gases, chemicals, oils, spirits, and ammonia solvents.

"Klinger-Oilit" —Oil resistant sheet packing intended for use in oil refining and distributing as well as for use with methyl-chloride and sulphur dioxide.

"Klinger-Acidit" — Acid resisting sheet packing, produced especially to resist hot nitric, hydrochloric and sulphuric acids, as well as most other organic and inorganic acids.

"Klingerit 1000" — Wire reinforced sheet packing for extremely high temperatures.

RICHARD KLINGER INC. 550, FOURTH AVENUE, BROOKLYN 15, NEW YORK
Manufacturing Licensees for Canada
JOSEPH ROBB & COMPANY LIMITED, 5575, COTE ST. PAUL ROAD, MONTREAL, 20, CANADA
Telephone: WILBANK 3181 *Cable: ROBCO*
Branches at: SYDNEY, HALIFAX, OTTAWA, TORONTO, HAMILTON, WINNIPEG, EDMONTON, VANCOUVER, QUEBEC CITY
RICHARD KLINGER LIMITED, KLINGERIT WORKS, SIDCUP, KENT, ENGLAND. *Cables: KLINGERIT*

STEVE ELONKA
Associate Editor in Charge

"See, wool-felt thickness is kept to close tolerances," says Jim Bowden, plant manager

Today, wool felt does many plant jobs for you

Basic data supplied by
T J GILLICK and R R STEVENS
Standards and Marketing Committee
Felt Association

► FELT'S BROADEST USES in the power-service field are as a preventive sealing and cushioning material against heat, cold, moisture, sweating, corrosion and vibration. Its inherent resistance to deterioration, wear, age or exposure makes it nearly indestructible. Basic fiber in felt is wool. And wool, when pressed into felt, stands up to running steel—it polishes glass-hard surfaces, withstands oil or hot, cold or salt water and resists many acids and chemicals. So nonwoven wool felt—as is, or with impregnants or synthetics added—serves the plant engineer as a useful, rugged mechanical material.

Industrial wool felt is a fabric built up by interlocking the fibers by mechanical or chemical action, moisture and heat. It may consist of one or more classes of woolen fibers, or woolen fibers mixed with other fibers.

Unlike textiles that have spun and twisted fibers woven or knitted into designed patterns, felt fibers are laid out in webs. These webs are then cross-lapped to build up to the desired thickness, making a sturdy product.

Individual wool fibers, when mass agitated, tend to curl and work their way into a permanent self-selected arrangement, with no distortion of their natural twists and bends. Felt can be processed to almost any consistency from downy soft to a density equivalent to hard wood.

It's easy to design products from felt since it's available in many densities, thicknesses and qualities. It can be die-cut, punched, chiseled, turned, scarfed and ground.

Mechanical wool felts are used to separate, support, protect, cushion, seal, wick, filter, polish and insulate.

Gaskets. Versatility of felt makes it especially adaptable for power-service equipment. You can make seals and gaskets on the job from felt sheet

FILTER INSERT controls particle retention and permeability for many uses

VIBRATION PADS of felt installed under gas engine and auxiliary generator. Cement anchors pads to the floor and to the machine's base, eliminates use of anchor bolts

You can now use treated, untreated, laminated

or rolls, or from processed felt tapes.

Mechanical grades of felt are made to standards developed by the Society of Automotive Engineers and adopted by the Felt Association, so you can determine felt performance with accuracy. Felt, meeting SAE standards and specifications, has thousands of mechanical and engineering applications where replacement is not anticipated. You should know them.

Vibration isolation. High resiliency, low-compression set and long-life characteristics make felt an ideal material for isolating vibration. It dampens shock and reduces transmission to adjacent surfaces or objects.

When properly loaded, felt pads reduce transmitted vibration from 60 to 85%. Dampening pads 1-in. thick will support 250 psi. These pads reduce transmitted vibration that shakes buildings, springs leaks, wears out machines and contributes to excessive plant noise.

When cemented to machine's feet and to the floor, these pads save floors as you don't have to drill holes for fastening. Pads anchor machines in place with cement adhesives, without bolts or lag screws. They permit quick location or line changes as need arises.

How do you move machines anchored on floor-cemented felt? Douse the pads or soak with alcohol or carbon-tetrachloride for 20 to 30 minutes, depending on adhesive used. Solvent softens the cement so you can easily shift the machine. Use a common spout-type oil can to slush the solvent on and around pads.

Equipment installed on dampening pads includes dynamos, compressors, cutters, generators, pumps, stokers, pulverizers, air-conditioning fans and blowers.

Wicking. Felt's wide range of capillarity, long life, nonfray characteristics and resiliency make it an ideal wicking material. Round or flat wicks and oil-storage parts lubricate electric motors.

Washers. Rolling-contact bearings, component parts of power machinery and equipment, have felt washers and seals. Washers retain oil or grease and exclude abrasive particles.

Felt plugs are inserted in air-compressor helical valve springs to lubricate and prevent corrosion. Many dust respirator filters are of felt, as are the air filters that remove moisture from compressed-air lines.

Insulation. Felt is used as an insulating material in air-conditioning systems. It also absorbs exhaust fan noises and covers hot and cold pipelines carrying either fresh or salt water.

Gaskets. As a supporting material felt has many uses as a gasket, washer or spacer. Since it prevents lubrication loss from within and entrance of dirt, dust and grit from without, felt is used widely as a seal.

Pistons. Grease-gun pistons and bumpers at piston bore ends have felt packing. Other felt packings are found in fire-extinguisher piston rods, valve stems, washers and rings in dispensing and measuring pumps. They're also used as gage-glass packing for oil, water and steam gage connections.

Filtration. Controlled permeability and particle retention efficiency of felt make it suitable for filtering air, gases and liquids. Also, wool is nonreactive to many chemical agents and felt can be made chemically neutral.

Special. Felt is ground or turned into spools, spheres, hemispherical bumpers, stepped washers, tapered buffers, etc. Combined with abrasive agents, felt wheels serve as grinders, polishers and buffers.

Felt is used as a carrier for such impregnants as adhesives, asphalt, graphite, paraffin, wax, natural and synthetic rubber, copper chromate and thermoplastic resins.

Sealing. Pressure-sensitive felts are useful for sealing and gasketing because the surface adhesive is forced into the mass of felt fibers under pressure. Thus, when applied between flanges or at lapped or butted joints, the felt seals itself, as well as the tightened joint.

There are many all-wool, pressure-sensitive felts. General-purpose felt has pressure-sensitive adhesive on one side with cloth backing. It's nontoxic, nonirritating and noncorrosive to all

TAPE used for this sheet-metal joint is noncorrosive, chromate impregnated

GASKET is resilient and it fills in surface irregularities when compressed in joint

ON-THE-JOB cutting is easy; felt cuts sharp, edges are unfrayed, shape holds

and special felts for many industrial jobs

metals. This material is impregnated with synthetic rubber-like adhesive containing inert mineral fillers that remain adhesive throughout the temperature range from –40 to 160 F.

A second type of adhesive-impregnated felt is tougher, easier to use. Adhesive is not backed, so you can apply it unrolled. Unaffected by citrus juices, alkaline cleaners, detergents, soaps and saline solutions, it's nonhardening and won't wick. It prevents seepage and corrosion and retards electrolysis when used between dissimilar metals.

Other types include fungus-, flame-, oil- and mildew-resistant impregnated felts, conforming to rigid government, naval and military specifications. These types won't deteriorate when exposed to salt water or lube oils.

Adhesive-backed impregnated felts are easy to cut, will not fray and can be applied to curved, overhead or vertical surfaces.

Asphalt impregnations produce a treated felt well-suited for weather sealing. For lubrication purposes, graphite-impregnated felt is a good material for oil seals, washers and antifriction lubricating pads. For waterproof sealing, lubrication and packing uses, different kinds of felts are impregnated with paraffin or petrolatum. These are for float-valve plunger washers, needle lubricating pads and various marine stuffing-box washers.

Resin impregnations increase life of felt by 150% where material must withstand abrasive wear and frictional heat.

Hycar, natural-rubber or neoprene impregnated felts are especially good for packing, sealing and gasketing. They give the double protection of positive sealing and self-lubrication for packing washers used in heavy-duty bearing seals. Hycar felts are recommended for service with gasoline or organic fluids; rubberized felts for hydraulic fluids, corrosive liquids or gases; neoprene felts for mineral oils and gases. Typical uses of latex felts include fuel-pump packing washers, mechanical seals for corrosive liquids, oil wipers, shock-absorber packing and bearing seals.

Resin treatments induce electrostatic charges and enhance the filtering properties of felts used for air conditioning and dust filtration. Pre-plugging of wool felt to a predetermined extent produces an electrostatic or physical attraction to the felt of minute particles in the sub-micron range. These filters guard against light organic fumes, vapors and gases; acid gases, fumes and mists; low concentrations of ammonia; and metal fumes found in welding, smelting and refining operations.

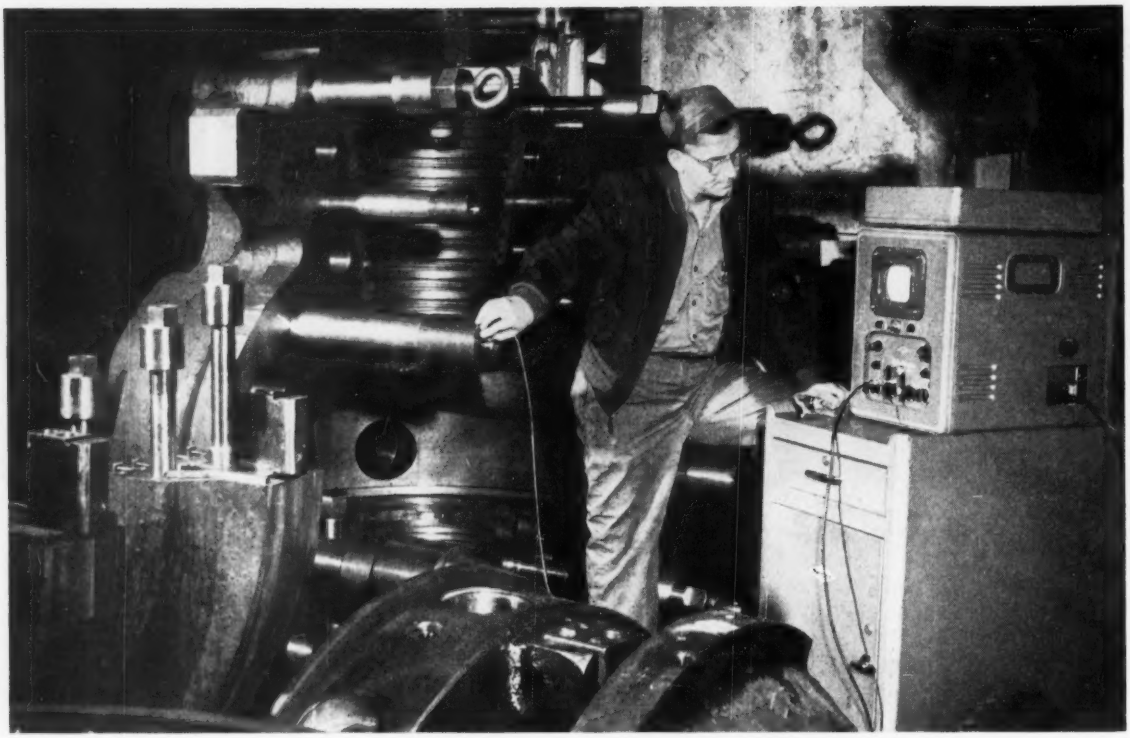
Laminated. Felts also are laminated in various ways and with different materials. Laminations increase resistance to the deteriorating action of liquids and solvents. These special felts are used for rigid packing and gasketing.

By laminating felt with rubber or synthetic-rubber latex, you can fabricate seals of smaller dimensions than possible with similar parts made of plain or untreated felts. Laminations give greater strength and stability to felt and allow closer working tolerances.

The rubber or synthetic barrier in a felt seal acts as a positive dam, prevents entrance of water, dirt and foreign matter from the outside and prohibits leakage from within.

Where shock-absorber packings are used with castor oil or glycerine hydraulic fluids, natural-rubber laminations are best. Neoprene is superior with mineral oils. Hycar laminations are best where high-octane gasolines or aromatic hydrocarbons are present. Hycar also is preferred to neoprene in low-viscosity oil applications where no swelling is permissible because of precision-fitted parts. In sealing against corrosive agents, such as chlorine, natural rubber and buna S appear to function best.

Felt is also laminated wth aluminum and lead foil for special purposes. Aluminum-foil laminated felt is used for reflectant and acoustical purposes and for thermal-insulating blankets. Felt, laminated with lead foil, is a good gasketing material for vapor seals in cold-line pipe installations.



PRESTRESSED TURBINE STUDS being tested for cracks. Operator can pinpoint any flaws having a minimum depth of .050 in.

Worried about cracked turbine bolts?

You needn't be. Ultrasonic inspection brings fatigue cracks out into the open

By **R N HAFEMEISTER**, *Non-Destructive Testing, Allis-Chalmers Mfg Co*

How ultrasonic inspection works

The reflectoscope, a portable electronic instrument, produces ultrasonic sound waves faster than speed of sound through air at sea level. Beamed into a metal object under test by a crystal search unit, the waves travel through the object, bounce back from the opposite side and are picked up by the search unit. Any crack or void in the waves' path also provides a surface from which they bounce back to the search unit. Since sonic waves accurately measure thickness of a material under test, they easily pinpoint location of defect in terms of fractions of total thickness of the material under test.

Invaluable as a nondestructive-test inspection tool, the reflectoscope can spot failures long before they happen.

► ULTRASONIC INSPECTION (box, left) gives a positive answer to the question of whether a steam turbine's prestressed bolts are faulty or sound.

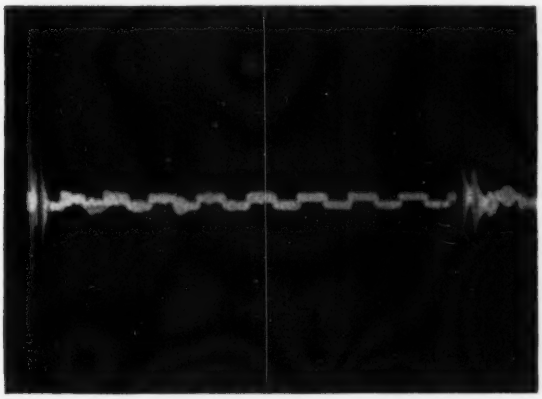
Fatigue cracks invariably develop while a bolt is in service and, with no detection method, get progressively worse until the bolt fractures. **A bolt** failure always means a forced shutdown.

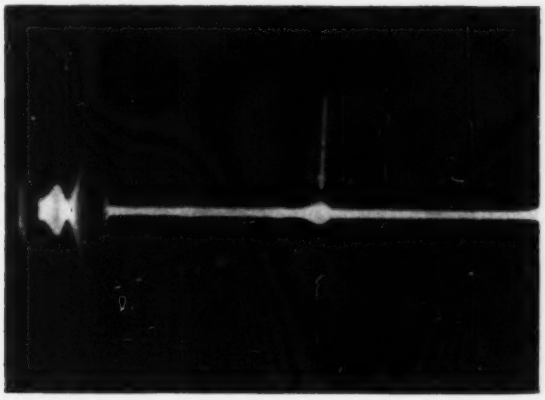
We figured this problem could be licked through ultrasonic inspection, so we set up a research program to develop a practical test procedure.

The bolts that secure a turbine's upper and lower casings are prestressed because of high operating temperature, plus required close tolerances. We ruled out possibility of removing the bolts for inspection because of the danger of initiating a fatigue crack during reassembly. If this happened, we wouldn't know it until the next inspection—provided the bolt didn't fail first.

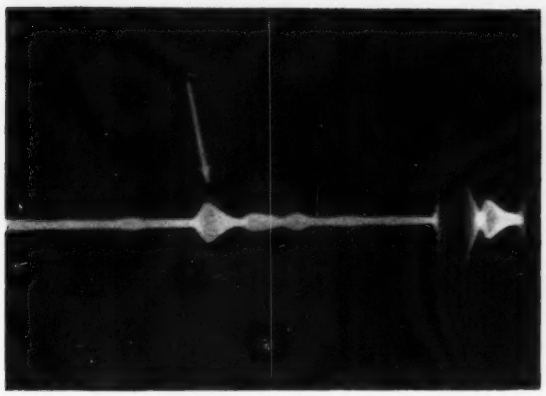
Inspection with the turbine running would be the ideal solution because we'd know, without interrupting opera-

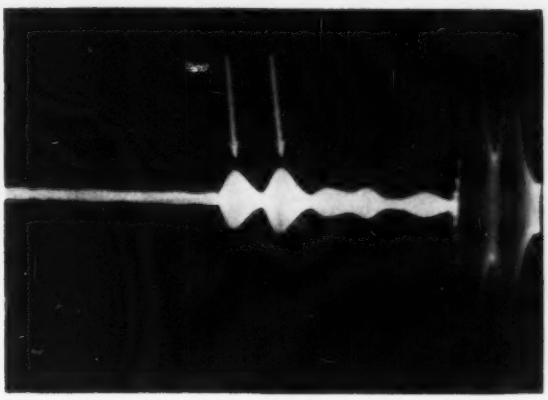
Reflectograms give permanent record of internal condition of materials tested





New stud, *left*, shows no defect. Same stud, *right*, with 1/16-in.-deep saw cut





Actual service-developed fatigue cracks. *Left*, .060-in. and *right*, .075-in. deep

tion, if the bolts were sound or if we should schedule a shutdown. We tried "in operation" inspection but it didn't pan out. Nor could we make an inspection as soon as the turbine stopped.

Bolt temperatures were too high for the reflectoscope crystals. Their limit is about 250 F which prohibits a reliable inspection until bolt temperature drops below this point. So we set the minimum standard of inspection to be with the turbine shut down, but all bolts in place and undisturbed. This would let us replace a cracked bolt immediately and eliminate waiting for a scheduled shutdown or worrying about a cracked bolt forcing a shutdown.

Reflectoscope choice was one we could use with one or two crystals and with available frequencies of 0.5, 1.0, 2.25, 5.0 and 10.0 megacycles. Bolts and studs to be tested were 2 to 2½ in. diameter, 18 to 30 in. long. Only one end is visible when they're installed, but possible flaws in each threaded end must be detected. We established a minimum datum of flaw depth of 0.050-in. We reasoned that such flaw depth wasn't dangerous, yet was deep enough to show a difference between a flaw and root of threads on the reflectoscope screen.

Next step was to make tests on guinea-pig bolts—some with artificial defects, others having actual service-developed fatigue cracks. These data were to be correlated with what we already knew about steam-turbine bolt behavior.

New bolts, taken at random from stock, were thoroughly inspected ultrasonically before given artificial defects, photo, above, top left. Reflectograms taken from both ends gave a permanent record of bolts' internal condition.

Artificial defects—thin saw cuts—were put in the threaded sections at varying distances from the ends. The cuts were hidden with masking tape so that the reflectoscope operator's interpretations wouldn't be influenced by any visible defects.

Besides locating defects, we wanted the test to provide information that would enable a routine inspection operator to know the following:

(1) What minimum depth of defect could be pinpointed from either end or in threaded sections adjacent or opposite to the test face.

(2) What interference, if any, with the above would reduce test reliability.

(3) What diameter-to-length ratio, if any, would reduce test reliability.

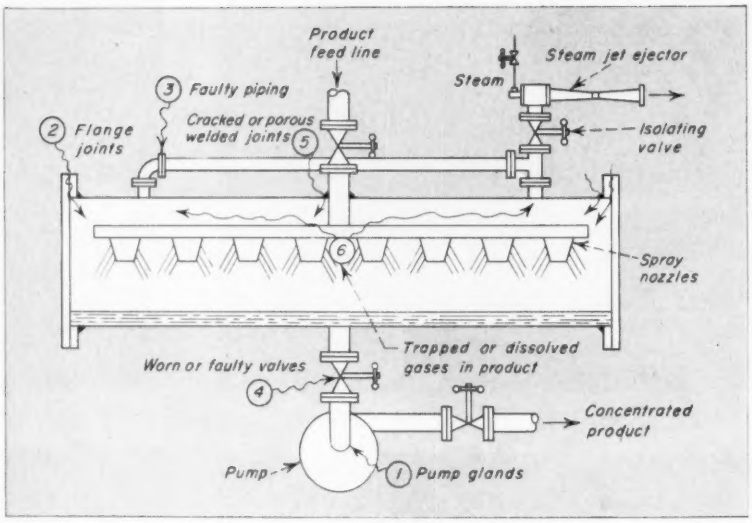
Test results from bolts having deliberately inflicted defects were gratifying. And, tested under identical conditions, bolts with service-developed fatigue cracks verified our findings that:

(1) Minimum depth of defect that could be accurately located from either end is 0.050 in., with no test surface preparation other than wiping or brushing. Only limitation is that, in first few inches from test face, detectable depth varies directly as the distance from the crystal. *Reason:* Bolt chamfer prevents crystal from lying flat and perpendicular to edge of bolt circumference. (Sonic waves travel in a

(*Continued on page* 174)

By F DUNCAN BERKELEY,
Graham Manufacturing Company, Inc

How much air leaks into your vacuum system? If an air meter isn't available, find out by trying this simple, positive method of . . .



AIR LEAKS are your vacuum system's bitterest foe. Keep an eye on six places shown in vacuum flash cooler system, above

Measuring vacuum-system air leakage

► ALWAYS ALLOW for air leakage in the design of vacuum producing equipment. Simple vacuum flash cooler, above, shows where air leakage can occur. Amount of noncondensable gases entering the system is readily calculated. But the future possible leakage is more difficult to predict accurately. So select vacuum pumps with some margin of safety to allow for a reasonable amount of leakage. If this margin is exceeded, the pumps will not meet performance guarantees.

When vacuum pumps give trouble, first make an air-leakage test. If leakage is excessive, then track down the source. If the system is tight, look for other possible causes.

Air-leakage test can be made with an air-leakage meter. If the system does not have one, another precise method is available. It is based on the fact that maximum possible air leakage into a system is constant when the system pressure is 53% or less of barometric pressure (about 15-in. Hg abs). After system is evacuated to some pressure below 53% of barometric pressure, time the system pressure rise from one reference point to another.

When system volume is known, only one time measurement is needed to determine rate of air leakage. If system volume is unknown, two time measurements are needed—one on the closed system, the other with an open orifice in the system to introduce air leakage of known quantity. Calculate unknown air leakage by using an inverse proportion of time and rate of air leakage for the two tests. Following examples illustrate how this is done.

Case A: Find the amount of air leakage into a 5500-cu-ft system. Use the test procedure outlined on the facing page to discover that it takes 75 minutes (4500 sec) for pressure in the isolated system to rise from 6 to 11 in. Hg abs. Use equation (4) to find the rate of air leakage.

$$X = \frac{45\,V}{t_x}\text{lb/hr, where } t_x \text{ is time for 5-in. Hg pressure rise}$$

$$X = \frac{(45)\ (5500)}{4500} = 55 \text{ lb/hr (Answer)}$$

Case B: Now assume that we do not know the volume of the system for Case A. It still takes 75 minutes for the pressure in the closed system to increase 5-in. Hg abs. From table of recommended orifices, select a 21/32-in. diameter orifice for a known air flow of 406 lb/hr. Install this orifice at some convenient place in the system. Follow the test procedure. It takes 537 sec with the orifice open for system pressure to increase from 6- to 11-in. Hg abs. Then use equation (6) to calculate air leakage:

$$X = \frac{(Y)\ (t_x + _y)}{t_x - (t_x + _y)}\text{lb / hr, where}$$

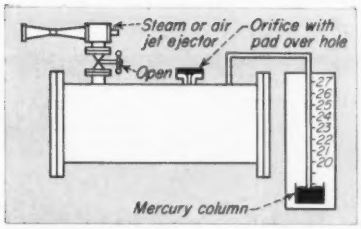
$t_x + _y$ is time for 5-in. Hg abs rise.

$$X = \frac{(406)\ (537)}{(4500 - 537)} = 55 \text{ lb/hr (Answer)}$$

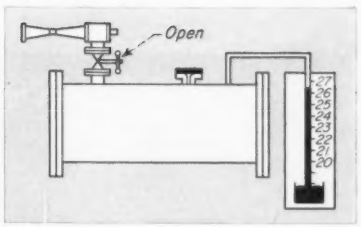
Test conditions. Pressure-rise measurements must be taken with all conditions the same as when system is operating under vacuum. Turning or sliding shafts and other moving parts where air leakage is found should be kept moving. Keep gland-seal steam turned on. With surface condensers, have enough water flowing to condense gland-seal steam entering the condenser. This avoids pressure rise from presence of steam which is condensed in normal operation. Errors resulting from ejector isolating-valve leakage can be eliminated. First perform test with ejector operating continuously. Then repeat with ejector shut off while timing the pressure rise. If the isolating valve doesn't leak, both tests will produce the same result.

Barometric pressure. Air leakage decreases about 3.2% per inch decrease in barometric pressure below 30-in. Hg abs. To correct calculated air leakage, multiply by the ratio of actual baro-

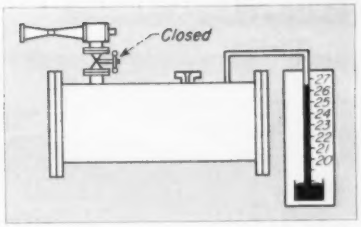
(Continued on page 226)



1—Isolate entire vacuum system



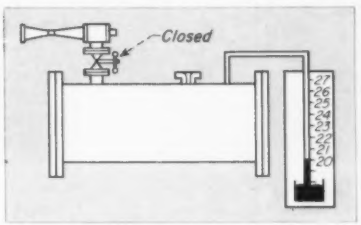
2—Start steam-jet ejector



3—Isolate ejector, remove orifice pad

Four steps give raw data to calculate leakage

First, isolate the entire vacuum system. Then start steam-jet ejector and open the ejector suction valve. Evacuate system to some vacuum well over 15-in. Hg. Then close ejector suction valve. If system volume is unknown, remove orifice pad to admit air at a known rate. Air also comes in from various unknown leaks. Note the time for vacuum to drop 5-in. Hg. Then repeat test with the orifice closed. Use these two time measurements to calculate amount of air leakage from equation (6), below. If system volume is known, orifice time is not needed. Then compute air leakage from equation (4), below.



4—Time 5-in. Hg drop in vacuum

Derivation of air-leakage equations

Let V = Volume of system in cubic feet
T = Absolute temperature of ambient air entering system (460° plus °F = °R absolute temperature)
P_1 = Initial system pressure (inches Hg absolute)
P_2 = Final system pressure (inches Hg absolute)
(P_1 and P_2 must be less than 53% of barometric pressure)
W_1 = Weight of air in system at P_1 in pounds
W_2 = Weight of air in system at P_2 in pounds
X = Unknown rate of air leakage (lb per hr) into system through cracks, mechanical shaft seals, valves and other joints
Y = Known rate of air leakage (lb per hr) through an orifice of known size selected from chart of recommended orifices
t_x = Time required (seconds) for pressure in system to increase from P_1 to P_2 with X rate of air leakage
t_{x+y} = Time required (seconds) for pressure in system to increase from P_1 to P_2 with $X + Y$ air leakage

Use characteristic equation of a perfect gas applied to air:

$$W_1 = \frac{(1.326)\ (P_1)\ (V)}{T} \text{ lb}$$

Then

$$W_2 = \frac{(1.326)\ (P_2)\ (V)}{T} \text{ lb}$$

$$W_2 - W_1 = \frac{(1.326)\ (P_2 - P_1)\ (V)}{T} \text{ lb} \qquad \text{Equation (1)}$$

$$X = \frac{(W_2 - W_1)\ (3600)}{t_x} \quad \frac{\text{lb}}{\text{hr}} \qquad \text{Equation (2)}$$

Substitute equation (1) in equation (2)

$$X = \frac{(1.236)\ (P_2 - P_1)\ (V)}{T} \times \frac{(3600)}{t_x} \quad \frac{\text{lb}}{\text{hr}}$$

$$X = \frac{(4773.6)\ (P_2 - P_1)\ (V)}{(T)\ (t_x)} \quad \frac{\text{lb}}{\text{hr}} \qquad \text{Equation (3)}$$

For $P_2 - P_1 = 5$ in. Hg and $T = 70$ F (530 °R)

$$X = \frac{(4773.5)\ (5)\ (V)}{(530)\ (t_x)} \quad \frac{\text{lb}}{\text{hr}}$$

$$\blacktriangleright\ X = \frac{45.0\ (V)}{t_x} \quad \frac{\text{lb}}{\text{hr}} \qquad \text{Equation (4)}$$

Using same method, formula for "X + Y" air leakage is derived:

$$X + Y = \frac{45.0\ (V)}{t_{x+y}} \qquad \text{Equation (5)}$$

From equations (4) and (5)

$$\frac{X}{X+Y} = \frac{(45V)}{t_x} \times \frac{(t_{x+y})}{(45V)}$$

$$\blacktriangleright\ X = \frac{(Y)\ (t_{x+y})}{t_x - (t_{x+y})} \quad \frac{\text{lb}}{\text{hr}} \qquad \text{Equation (6)}$$

Recommended orifices

System volume, cu ft	Orifice diameter, inches	Maximum air flow lb/hr*
50	1/16	3.65
100	3/32	8.25
200	1/8	14.7
300	5/32	23.0
400	3/16	33.2
500	3/16	33.2
600	7/32	45.1
700	7/32	45.1
800	1/4	59.0
900	9/32	74.7
1000	9/32	74.7
1200	5/16	92.1
1400	11/32	111
1600	11/32	111
1800	3/8	133
2000	13/32	156
2500	7/16	181
3000	1/2	236
3500	17/32	266
4000	9/16	293
4500	19/32	332
5000	5/8	368
5500	21/32	406
6000	11/16	446
6500	23/32	489
7000	3/4	530
7500	25/32	575
8000	13/16	623
9000	7/8	723
10,000	15/16	830

Orifice sizes for given system volumes giving a 5-in. Hg pressure rise in about ten minutes *(Based on 30-in. Hg abs upstream with downstream pressure 53% or less of upstream pressure using orifices with a well-rounded entrance.)

PERFECT condition of diesel-engine cylinder head isn't accidental. Select the right treatment method. Then follow up with regular application and periodic checks for topnotch diesel cooling water system performance

RUINED cylinder head was caused by corrosion and pitting. Proper treatment program, including the use of a suitable corrosion inhibitor, is right way to prevent this kind of trouble

Diesel cooling water

Combat scale and corrosion by using the right

► CORROSION AND SCALE make it just as costly to use the wrong cooling water as it is to burn the wrong fuel. Scale and corrosion products impede heat transfer, cause engine overheating. Corrosion, if unchecked, can also waste enough metal to cause cooling-system failure.

To prevent trouble of this kind, first clean and descale your system thoroughly. Follow the typical procedure given on the facing page. Cooling system must be completely clean before any water-treatment program can be effective.

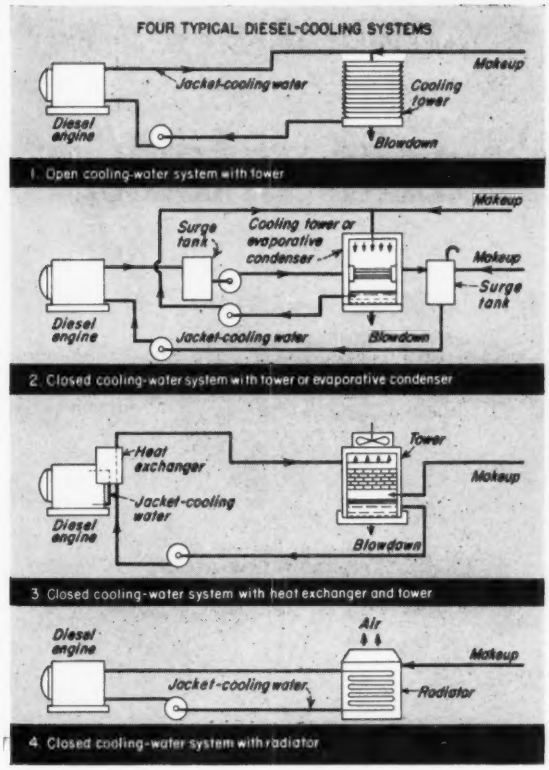
Cooling-water systems are divided into three broad types —once through, open recirculating and closed recircuating. In the once-through system coolng water makes one pass through the heat-exchange equipment. No evaporation takes place; water is merely increased in temperature. Since the water is eventually discharged to waste, its use is limited to areas with an abundant supply of cool water.

Trend is toward recirculating systems where water is saved by continuous reuse. Four diesel-engine cooling systems, facing page, illustrate open and closed systems of this type. Open system evaporates a portion of the recirculated stream for cooling. Closed system uses a radiator or other closed heat exchanger for this purpose. Open system is used for the large cooling-water flows in refineries, chemical plants and steam-generator condenser cooling. Closed system is more frequently used for diesel-engine and compressor cooling. Note that even though systems two and three are classed as open systems, secondary systems are the open type. Once through system can also be used.

Treatment and control of cooling water passing through the diesel water jacket is simplified by the closed system. Water loss is a minimum. Solids concentration caused by evaporation in an open system is avoided. Major water treatment problems are transferred to the secondary system. There the problem is not as acute because temperature rise of th cooling water can be kept down.

A large number of cooling-water system combinations are possible. But, the water problem boils down to treating closed, open and once-through systems. Economics plays an important role in selecting the best method of treatment. Water analysis, flow rate, and type of hookup vary so much that each installation needs individual study. An outline of the treatment methods in current use will help you to evaluate their merit for your cooling-water system.

Closed recirculating systems. Little or no concentration takes place and makeup for leakage is very small. First analyze the water used for the initial filling. Engine manufacturers recommend at least softened water. This is usually adequate if total dissolved solids content is not too high. For some locations 400 ppm is not unusual. In that case try and obtain another source of water. If this is impractical, investigate the use of package or cartridge type demineralizers for treating all or a portion of the initial fill.



needs treatment

method for your system

Same equipment can also supply any makeup needed and is available for emergency refills. Package and cartridge type softeners are also available if a soft-water supply is not at hand.

Soft or demineralized water will not form scale but the system must be protected from corrosion. Use any of several chromate or organic base inhibitors on the market for this purpose. Complete protection is usually obtained with 300 to 500 ppm of chromate. Some jobs may require as much as 6000 ppm. Since water loss is small, it is a good idea not to skimp on the dosage. But don't feed more than is necessary on a given job. *Remember:* Some systems require more chemical than others. When enough chemical is added, and the concentration is regularly checked, frequent cleaning and descaling will be unnecessary.

Open recirculating systems. Cooling-tower water losses from windage, leakage and evaporation are fixed by tower design and geographic location. Tools for water-treatment control include blowdown of circulating water to keep total dissolved solids from exceeding solubility limits and treatment of makeup water added to compensate for total water losses from the system, including blowdown.

Analyze makeup supply. Then accurately estimate leakage, windage and evaporation losses. Use blowdown to keep recirculated dissolved solids below saturation level. Then calculate Langelier index of the (*Continued on page* 230)

Clean and descale your water system

If the diesel engine overheats, it is probably caused by scale or corrosion products deposited in the engine water-jacket or heat-exchanger surfaces. First step is to completely clean out the entire water system and then follow up with a regular program of proper water treatment. Remember that cleaning and descaling does not replace water treatment. But when handled right, it will help you get a fresh start with a clean system. Use the following procedure as a general guide. In each individual case consult the diesel-engine manufacturer for recommendations and help.

Preclean system to remove dirt, oil, and grease

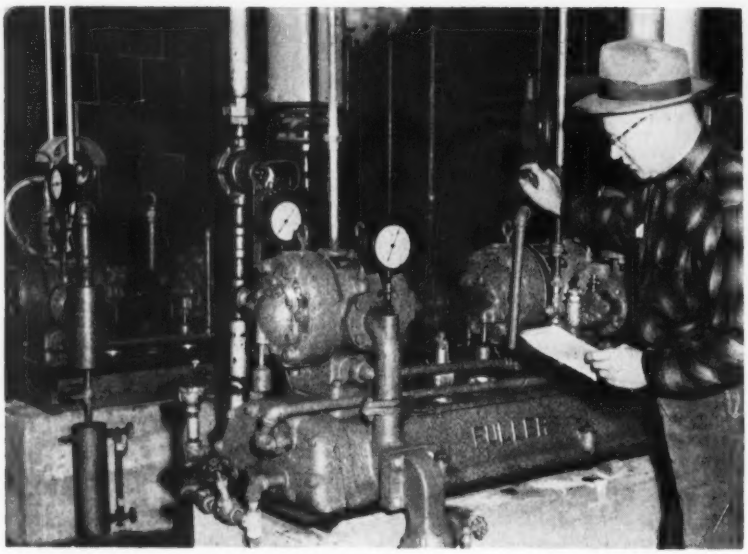
- Use an open steel drum or soft-water holding tank to hold the cleaning solution. Obtain a small auxiliary pump in acid proof construction for temporary or permanent installation in the cooling system. Details of hookup will vary with each installation. In every case, pump is installed to pump cleaner into engine-manifold water inlet. Regular water-circulating pumps are then by-passed to prevent damage from chemicals and foreign matter.
- Drain the system and refill with clean water. Leave water level at the half way mark in the soft-water makeup tank or the steel drum.
- Add cleaner to the tank or drum. Use commercial sodium carbonate or any of several special cleaners made for this purpose.
- Start auxiliary pump and circulate cleaning solution through the cooling-water system including the diesel water jacket and the external heat exchanger.
- Run the diesel engine at idling speed to keep cleaning solution at a fairly high temperature, around 150 F.
- Circulate solution anywhere from ¾ to as long as two hours depending on internal condition of the system.
- Stop the engine dead and flush system with clear water. Observe condition of water flushed out. From this you can tell how effective cleaning operation was and whether or not another try is necessary. System is now ready for descaling.
- If cleaning operation is not to be followed up with descaling procedure, drain the system and refill with clean treated water. Circulate for another half hour or so to be sure system is free of all chemical cleaner.

Then start descaling operation

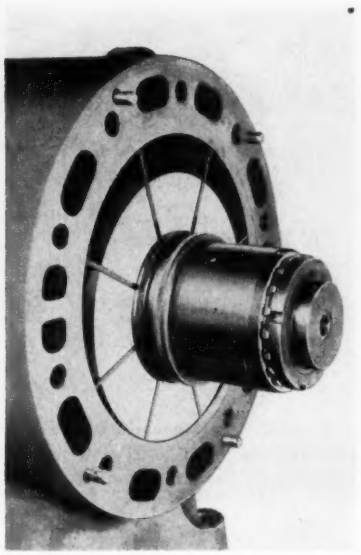
- Add descaling chemical to the open steel drum or soft-water holding tank. Use an inhibited acid. Strong alkalies such as caustic soda should not be used. They attack the nonferrous cooling-system parts.
- Circulate inhibited acid solution at the rate of 5 gpm. Higher rates may retard cooling-system descaling.
- Circulate solution for about 15 minutes and then drain system.
- Remove one of the cylinder liners and check results. If descaling is only partially completed, replace the adapter and circulate 15 minutes more. If scale has been hardly touched, use a slightly stronger descaling solution on the second try.
- Alternate check on results is obtained by checking strength of descaling chemicals at intervals by titration. Add chemical as needed to maintain initial concentration. When solution strength remains constant, complete scale removal can be assumed.
- Descaling mixture should not exceed a strength of two parts water to one part chemical. Do not circulate longer than a total of 20 minutes with one 15-minute check.
- Completely flush out engine with continuous supply of fresh water for 30 minutes. Do not recirculate same water.
- Add small amount of sodium carbonate or other alkaline cleaner to assure an alkaline recirculating water. Drain and flush system again after a short recirculation. Refill with treated water. Cooling-water system is now ready for return to service.

OPERATORS' NOTEBOOK 107

Let's take a look at



TWO-STAGE COMPRESSOR runs continuously, supplies 125 psi air to automatic extrusion machine in sewer pipe plant. Intercooler is in the base of this machine



SLIDING VANES move in slot; are held against the cylinder by centrifugal force

How compressor works

► POPULAR 2-STAGE AIR COMPRESSOR is the rotary, sliding-vane type. Air is trapped between the vanes as the eccentrically mounted rotor passes the inlet opening, making it a positive displacement machine. As rotor turns toward discharge port, volume of cell between any two vanes decreases and air pressure rises to rated discharge value. Centrifugal force holds vanes against bore, preventing trapped gases from slipping by. Thus vanes act as pistons and valves.

Machine is designed for common electric motor and internal-combustion engine speeds—needs no speed reducer. Since it's a rotary unit, air flow is free from pulsations.

Each unit or stage has a cylinder with heads and is water jacketed. Steel rotor, with integral shaft, is arranged eccentrically within the cylinder on same vertical center line. Shaft is supported on radial roller bearings in each head.

Blades, made of a thermosetting plastic composition or metal, slide freely in slots. Eccentric mounting of rotor inside cylinder forms a free space, crescent-shaped in cross section, divided into compartments by the blades. Volumes of compartments vary from minimum to maximum on intake or suction half of revolution; then from maximum to minimum on compression half.

Lube oil is force-fed to cylinder and to bearings, forming a thin film of oil on the running surface of cylinder wall. This lubricates blades and cylinder.

Single-stage machines are OK up to 10 to 50 psi. Use these units in zones requiring pressures lower than carried in central system. Zoning saves network of distribution system and need for reducing pressure from a central plant.

Pressure regulator. Pressure in system moves spool valve, Fig. 4, from bottom to top seat, admits air behind small piston. Piston acts against main valve, moves it to its seat. At same time, relief valve opens, venting air trapped in cylinder to atmosphere. Thus machine runs continuously, as regulator is controlled by pressure rise and fall in air receiver or discharge lines. Operation is automatic, needs no attention once it's set. Two simple adjustments allow variations in pressure or range setting if needed.

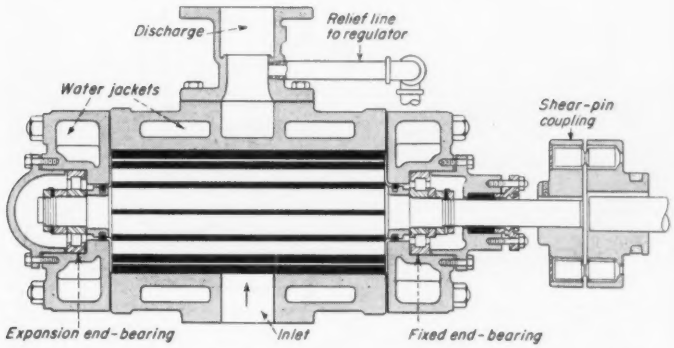
Multiple unit hookup. Have one unit on start-and-stop, while additional units run continuously. Two-stage machines are for pressures over 50 psi, as they are more economical at higher pressures than single-stage unit. Final air temperatures are also much lower. For capacities through 229 cfm (actual free-air delivery) at 100 psi, machines have intercooler tube nest in base. Larger units have separate intercooler. Two-stage machines are normally direct-line coupled to prime mover; no speed reducers are needed.

Maintenance. Open machine about once a year. Examine rubbing surfaces for wear. New vanes are same width and length as slots. Keep suction filter clean to keep contamination out of cylinder. Adjust mechanical lubricator feeds properly and see that reservoir always has enough oil so it is visible in the lubricator gage glass. Keep enough cooling water flowing through the cylinder jackets and intercooler to hold temperature where needed (usually about body temperature at final water outlet funnel).

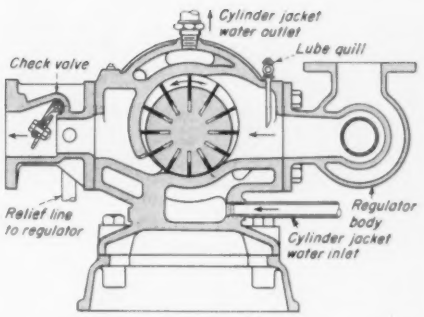
— *Courtesy, Fuller Company, Catasauqua, Pennsylvania*

the sliding-vane compressor

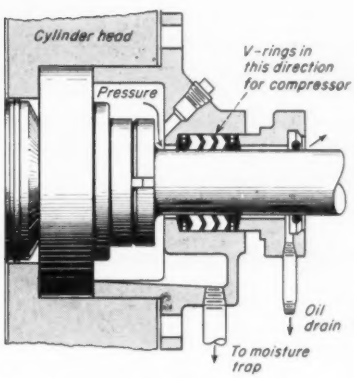
By STEVE ELONKA,
Associate Editor



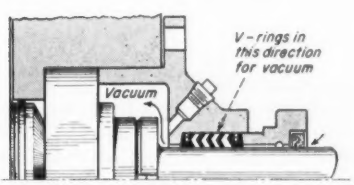
1 Rotor has fixed roller bearing at one end, floating bearing at other to take care of the longitudinal expansion and contraction differences



2 Blades automatically compensate for wear; check degree of wear when opening unit

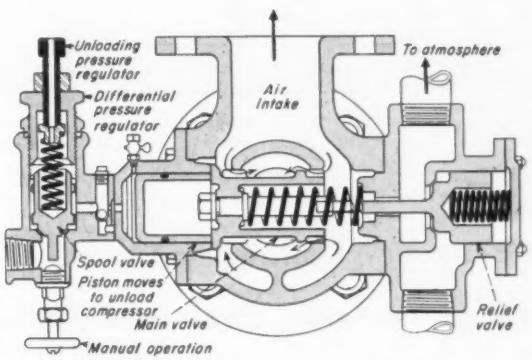


A Compressor packing set



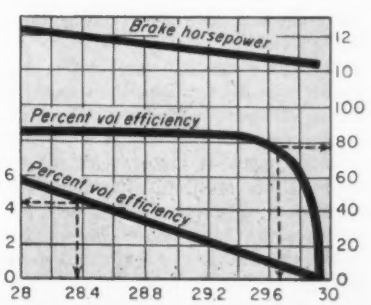
B Vacuum packing set

3 Typical packing arrangements for air service only. As you can see, V rings are not installed in the same direction in the vacuum and compressor machines. Experience shows that these packing sets run for long periods, with little or no gland adjustment required

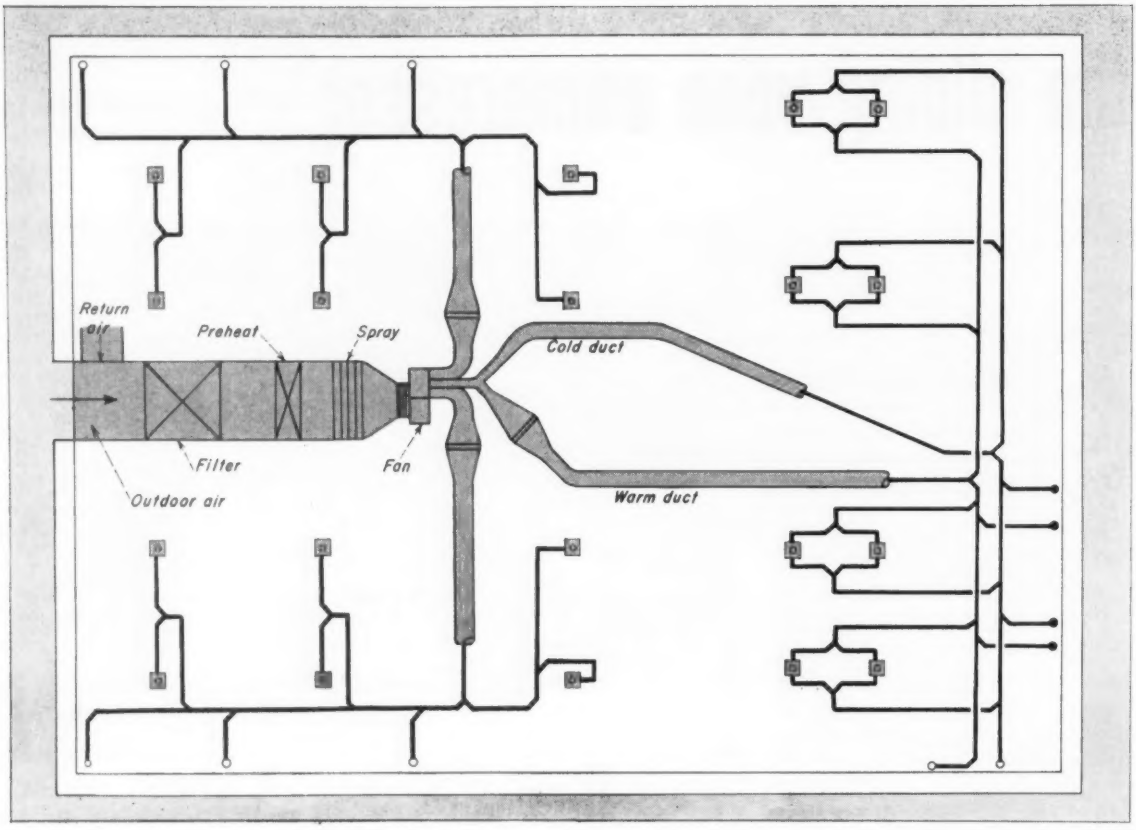


4 Regulator is controlled by pressure rise and fall in air receiver or discharge line as compressor runs continuously

Used as a vacuum pump



Vacuum pumps (sliding-vane type) are very similar to the compressor just described. Single-stage machines create vacuums up to 29.5 in.; compound machine up to 29.95 in. (referred to 30-in. barometer). Above 28 in. vacuum, 2-stage vacuum pumps are recommended because of their high volumetric efficiencies. Curve at left shows typical characteristics of these compound vacuum pumps between 28 in. and 29.95 in. mercury. Absence of vibration and air pulsations are often an important factor for application of these pumps.



DUCT LAYOUT for a two-story office building. The dual-duct and single-duct systems are both operated from the same fan. Excessive noise in executive offices served by dual-duct system was eliminated after thorough examination of units

High-velocity air-conditioning systems can run into trouble because of poor

Bill Waeldner. He cites three case studies to show...

Why h-v air-conditioning systems

► In February Power, pp 118-119 we talked about ways to balance high-velocity air-conditioning systems. Now let's see what some possible operating snags are—and how we can avoid them.

Operating troubles in high-velocity air-conditioning systems generally stem from a poor understanding of system principles or system design. A look at some actual installations shows how ignoring simple principles can lead to "bugs" in the system.

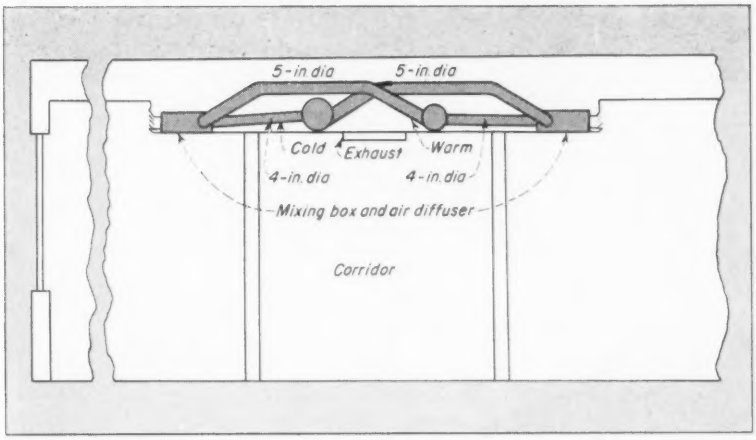
In a completely air-conditioned two-story office building, the duct layout, drawing above, was installed. The building is divided into three zones—east and west single-duct zones, and a south dual-duct zone. This is a novel arrangement because a single fan supplies air to both single- and dual-duct systems. The dual-duct zone supplies air to the executive offices, library and board room.

Attempt to balance the system resulted in noise levels in the executive offices that were well above acceptable decibel values. Here's what we found when we analyzed the system:

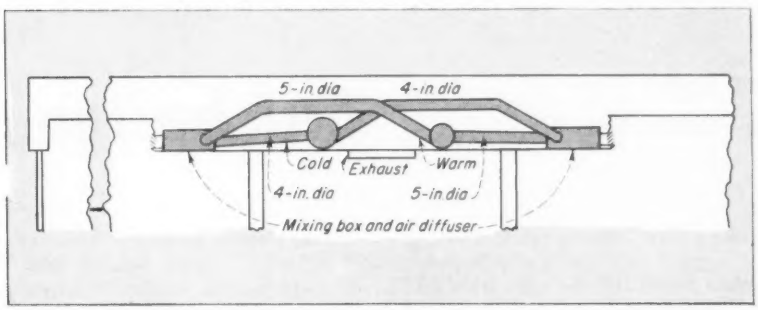
(1) There was no adjustable fan-speed control or other volume control on the entire supply-duct system. (2) Static pressure at the dual units supplying air to the executive quarters was more than 3-in. wg. High-velocity units were selected for only 1¾-in. wg. (3) Units at the end of the duct run —especially in the dual-duct system— handled required air capacity with the high-pressure unit valves substantially closed.

To reduce noise level in the executive offices we had to cut down duct pressure in the dual-duct system without appreciably changing pressure available for the single-duct zones.

An inlet vane damper wouldn't do the job because a fan damper or changing the fan drive would alter the complete system pressure. Fortunately, the dual system started as a single duct from the fan plenum. Thus installa-



INTENDED DESIGN layout shows runouts from the warm and cold ducts in a two-story building. Short lengths were to be 4-in. diameter with long runouts 5-in.



ACTUAL INSTALLATION showing the runouts to the diffusers. Sheet-metal contractor used 4-in. diameter for cold branch ducts and 5-in. for warm ducts

understanding of basics, says Anemostat Corp's

sometimes develop snags

tion of a damper in the duct before the split to warm and cold, proved to be practical. Since the damper was in a duct common to both warm and cold, pressure drop across the damper was constant. The damper "killed" excess pressure, reduced the sound level in the previously troublesome executive area. We had to service this job mainly because a volume control was omitted on the original system design. Result was a failure to balance the system for minimum required pressure.

Drawings above show another dual-duct installation that developed snags because system fundamentals were ignored. Basic floor plans for the first and second stories are identical. Equipment is in the basement. Building is two bays wide with a central corridor down the center of each floor. High inside-wall straightline units were installed. Double glazing eliminated the cold down draft during winter heating cycle. After installing the system and trying to balance it, the consultng engineer found that units on one side of the building would handle only 90% of design volume on the cold duct while handling 110% on the warm duct.

A look at duct design drawings showed that the warm ducts had a slightly higher resistance. Thus a greater volume of cold air should have flowed through any of the cold ducts. A check of the actual air volume through the units showed the engineer's findings to be correct.

Fortunately the attic crawl space was accessible from the second floor exhaust grilles, so we were able to inspect the actual duct and compare it with design drawings. We found that the contractor had pulled a serious boner in installing the ducts. Drawings called for the long runouts to be 5-in. diameter flexible duct, short lengths to be 4-in. diameter. Instead, the sheet metal contractor used 4-in. diameter for the cold branch ducts and 5-in. diameter for the warm branch ducts. Drawings left. compare design plans with the actual installaton.

The inspection and our prevous study clearly pointed up the cause for unusual flow in half of the building. We found the condition further aggravated in the flexible branch ducts to the units. Flexible tubes were bent around a short tight radius which increased flow resistance sharply. For example, if the flexible material collapses inside the tubing to a height of only $\frac{3}{8}$ in. on the 4-in. diameter duct, air velocity climbs $1\frac{1}{2}$ times.

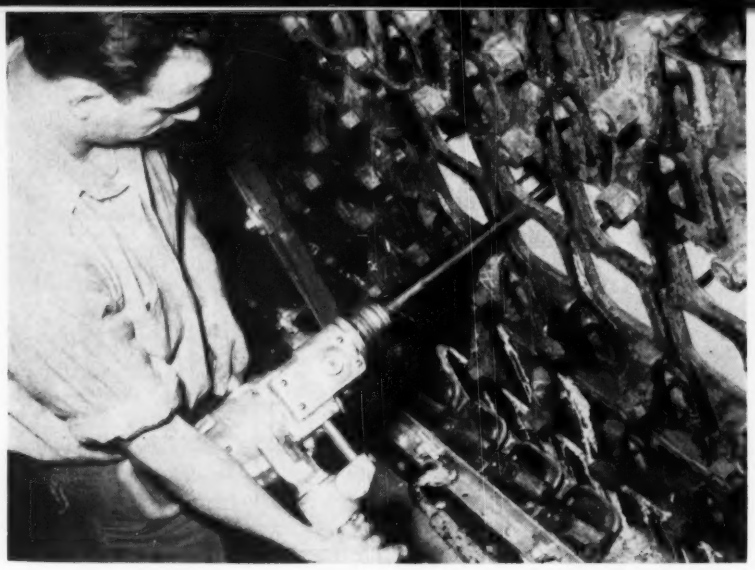
To get enough pressure to pass design flow through the cold inlets of all units, we agreed to increase fan speed and rebalance the system. This would mean the warm duct could deliver more air than its design capacity. But only during early morning warm up would full warm capacity be called for by the thermostat.

One of the largest dual-duct high-velocity systems ever installed ran into operating snags because system fundamentals were ignored. This installation serves two floors covering 1,280,000 sq ft. A typical fan system handles 40,000 to 60,000 cfm through more than 100 units.

When operators checked the balance capacities turned in by the contractor, the two sets of figures didn't agree. A follow-up check showed us the system was originally balanced with all air through the cold duct. But when operators ran their capacity check, system was running under control of the room thermostats, causing supply air to flow through both ducts. Resulting change in duct static pressures varied air flow capacities about 10 to 15%.

One unit on this job, located between two other units that balanced perfectly, was feeding too much hot air and too little cold air. After checking controls and finding them in order we decided to check the supply duct. Our inspectors discovered a piece of insulation lodged in the duct, preventing normal flow to the unit.

By A JOHN, *Thos C Wilson, Inc*



MEASURING TORQUE at mandrel, tool stops expander to prevent over-rolling

Clean, tight tubes mean better boiler performance. But you need time-saving tools to...

Cut boiler-

► BOILER OUTAGE for cleaning, inspection or repair is an important factor in a first-class preventive maintenance program—but outages cost money in time and labor. Keeping them to a minimum boils down to good planning, plus use of right maintenance tools.

Tube maintenance consists basically of keeping tubes clean and ends leak-tight. Occasionally, it's necessary to put in a new tube or repair a tube by fusion welding. Fusion-welded repair can't be a hit-or-miss business. The National Board of Boiler and Pressure Vessel Inspectors' *Rules for Repair of Power Boilers and Pressure Vessels*, and Section I (Power Boilers) of the ASME *Boiler and Pressure Vessel Code* have strict limitations in connection with installing and repairing tubes. Best bet is to check with your boiler inspector before you do any tube work, other than rolling leaky ends.

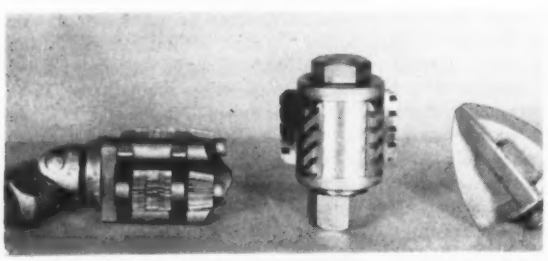
Tube cleaning, in particular, can eat up a lot of time unless the plant has efficient power-driven tools. To pick the right tools you need to know (1) types of tubes you have (2) general nature of deposit in tubes (3) type of power available.

All tube cleaners operate on essentially the same principle. They turbine or "punch" the tubes with air, water or steam motors or electrically-driven flexible-shaft units. These drive the revolving brushes, cutters or other heads through the tube to dislodge scale or other deposits which retard circulation.

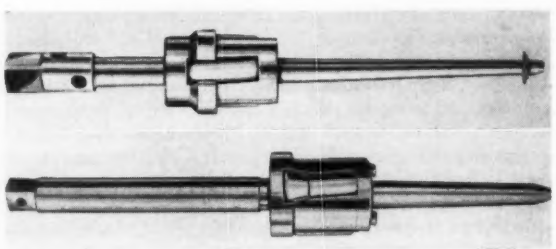
Typical cleaner heads are shown in Fig. 1, below. Cutter handles thick hard scale in either straight or curved tubes. Its sharp multiple-cutters chip and pulverize the scale. Expanding scraper has sharp hardened-steel members fixed to the sides of the holder. They scrape away gummy or wet deposits that would clog brush bristles. Drill head is used for the first pass through a tube that's clogged too solidly even for a cutter head. (It's difficult to understand how boiler tubes are permitted to reach a condition such as this —but some are).

Expanding wire brush, least expensive of the accessories, is for the deposit that's neither hard nor gummy. Its wires are arranged in tufts or clusters to form

Power-driven, these tools save downtime, labor



1 Cutter head, *left*, gets hard scale. Expanding scraper, *center*, cuts gummy deposit. Drill, *right*, clears clogged tube



2 Tapered mandrel expands longitudinal rollers as they feed into tube end. Note flaring rolls, *bottom*, for watertubes

EXTENSION MANDREL, universal joint or geared drive for hard-to-reach tube ends

tube repair costs

a cartridge, Fig. 3. Cartridge mounting allows some radial play. When brush revolves, centrifugal force holds wire tufts against tubewall. This tool is the most widely used. It's popular because it costs little to replace a worn cartridge.

Waterside scale on tubes in firetube boilers is almost impossible to get at with hand or power tools. This is where the vibrator or "knocker" comes into play, Fig. 4. It has a loose-fit eccentric steel disk on the shaft. During rotation, the disk slaps the tubewall sharply and the resultant vibration knocks the scale from the tube.

To repair leaky tube ends, or to put a new tube in a boiler, requires use of a tube-end expander. Expanding is nothing more than cold-working the tube end to form a tight frictional joint with the tube sheet. Most common expander has three rolls mounted through longitudinal slots in a cylindrical cage. Slots hold the rolls loosely, allow them to move laterally. A free-moving tapered pin or mandrel fits through center of the cage and bears against the rolls. With expander in the tube end, the mandrel forces rolls outward, turning both mandrel and rolls. Forward motion, combined with rotation, expands tube slowly and smoothly against the tube sheet.

Firetube boilers usually have their tubes rolled with expanders that leave the tube ends roughly parallel to the tube axis. The tube stock extending through tube sheet is "belled" with hand or power tools, then beaded against tube sheet to prevent tube ends from being burned by the hot gases.

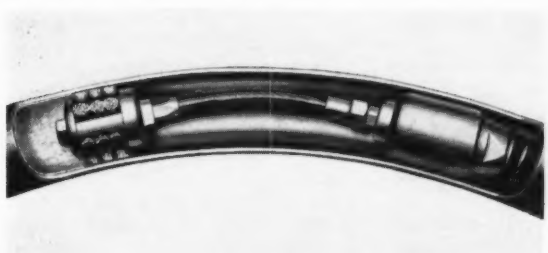
Watertube boiler tubes, however, must have the ends flared if they are not to be welded (ASME *Boiler Code*, Par. P-251). Flare must be at least $\frac{1}{8}$-in. more than tube-hole diameter. This calls for an expander that will roll and flare in one operation. Usually the last step in expanding, the flaring rolls follow the expanding rolls on the tool and gradually flare the tube stock extending beyond the tube sheet. Fig. 2 shows both firetube and watertube types of expanders.

Extension drives, mandrel drivers, universal joints and right-angle gear drives are used to get the expander in position to roll hard-to-reach tube ends in such spots as waterwall and superheater headers. These tools, when power-driven, are real time- and labor-savers.

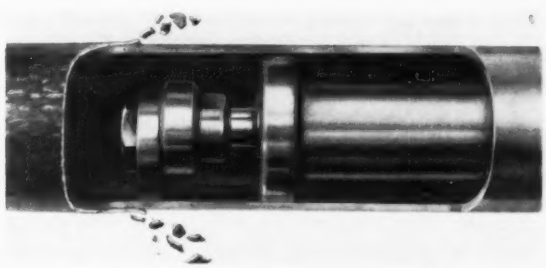
Expanding is a tricky operation in that tube ends have to be rolled leak-tight, but not over-rolled. Under-rolling means a loose, leaky joint, while over-rolling can stress or "work-harden" the metal, cause it to fail in service. Whether expanding is done with power tools or by hand, it takes experience to get the "feel" of rolling tube ends.

In most jobs, tube rolling is done in several stages. Some ends will need rerolling following the necessary hydrostatic test because it's difficult for the operator to adjust for changes in "feel" caused by variations in tubewall thickness or tube holes.

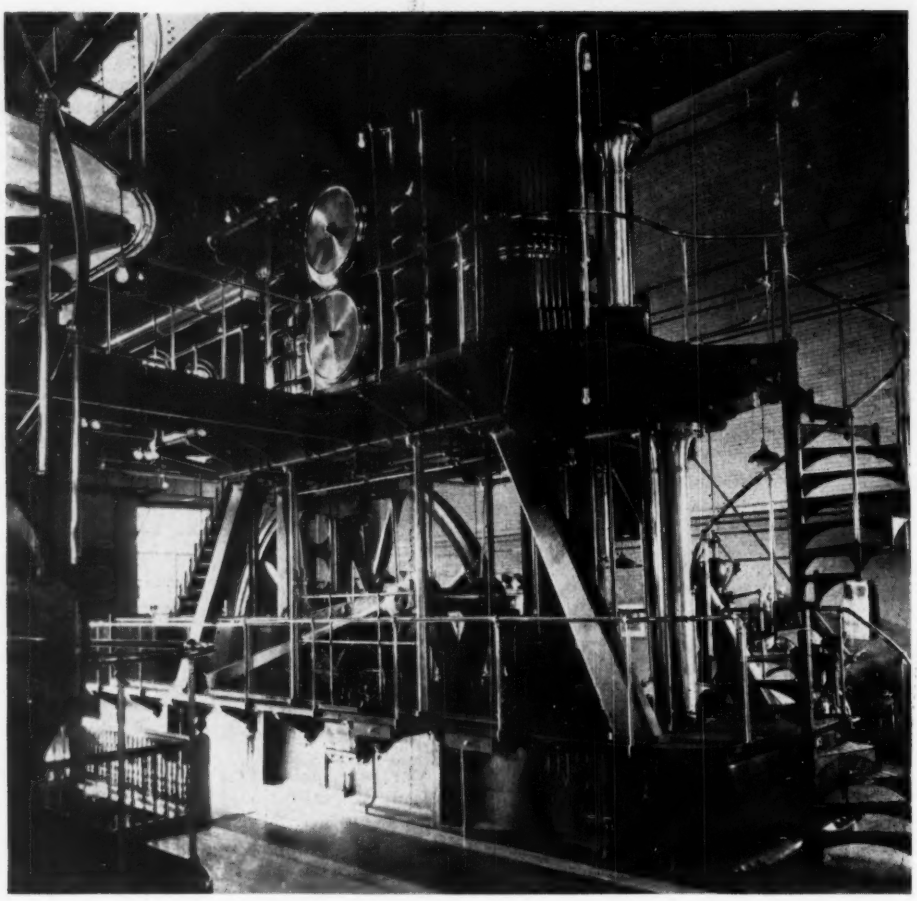
New tools which have built-in torque-measuring features take guesswork out of the job. Photo, top of p 122, shows a tool that automatically measures torque directly at the mandrel and stops expander rotation when the pre-set torque is reached. Using a control which lets you pre-set the torque limit prevents over-rolling and gives good uniformity of expansion regardless of tube hole or wall-thickness variations.



3 Expanding wire brush handles soot, flyash. Cartridge has radial play; centrifugal force holds tufts against tubewall



4 Vibrator, or "knocker," for waterside scale on tubes in firetube boiler. Eccentric slaps the tube during rotation



FIFTY YEARS of steady pumping service marked this engine's career before it was retired in 1950. Its long useful life is a tribute to fine workmanship, plus good operation and maintenance practices

These 3 lubrication tips help keep steam engines on the job

While many grand old engines are now only pleasant memories, keeping others running is sometimes still a big problem. Here a lubrication engineer solves three perplexing troubles

By SIM JESTER
Gulf Oil Corporation

► EXCEPT IN SOME industries requiring process steam, comparatively few reciprocating steam engines are being installed today. But in some older established plants you can still see these faithful engines chugging away.

Here's some info on their lubrication and three tips that may help keep your veteran equipment out of trouble.

Lubrication. A typical stationary steam engine needs two different kinds of oils. (1) The cylinder oil—a very heavy oil frequently compounded with animal fat such as tallow. It provides a film inside the cylinder and valves in the presence of steam and moisture. (2) The bearing oil—a medium viscosity straight mineral oil. Quality required depends on the method of applying the lubricant to the crankpin, crankshaft, crosshead, etc, bearings.

1 Avoid excess radiated heat

Not long ago I had a complaint that cylinder oil was plugging the oil feed lines and causing an engine to groan. Plant men claimed they had received a bad batch of oil. There were three steam-engine-driven horizontal two-stage air compressors in the plant's pump room. Steam end of each compressor was lubricated with a mechanical forced-feed lubricator. There were several feeds to each engine.

But only one unit was in trouble. So I quickly asked why they felt the oil (which they had used for several years) was at fault if two of the compressors still ran OK. They couldn't quite explain this.

Here's what the trouble boiled down to: Oil pipe feeding the piston valve on the side of the one engine repeatedly plugged up. Plugging was especially noticeable after a shutdown. With the oil supply cut off, the piston valve stuck and damaged the valve gear.

So far as drive arrangement, size and lubrication were concerned, all three compressors in the pump room were similar. I tried to find the difference, if any, that could account for the trouble with just one unit. Finally I spotted something that could do it.

Less than a foot away from the ailing oil line, directly over and parallel to it, was a 12- to 14-in. section of bare steam pipe. For some reason the insulation had been removed at this particular spot. Steam lines to the other engines were properly insulated.

Steam temperature had recently been boosted from 440 to 500 F. This increase was probably enough to change an unfavorable condition into a source of trouble. Heat radiating from that short section of uninsulated pipe baked the oil in the Parker fitting at entrance to the piston valve, but also probably caused distortion of the piston valve housing. This would make the valve groan regardless of oil stoppage.

When I pointed out these conditions, the engineer apologized for blaming the oil and promised to lag the piping as soon as possible. He was convinced that it would pay him.

2 Check quill condition every six months

A brewery had some large steam-engine-driven ammonia refrigeration compressors. The engineer objected to the excessive oil required to lubricate the steam cylinders and keep his biggest engine from groaning. With the former oil, consumption had been about half as much. This engine had a simple arrangement of a single oil feed to a quill inserted in the steam pipe about 6 ft above the throttle valve.

Theoretically, the arrangement was excellent. When I visited the brewery I asked when they had last examined the quill. No one seemed to recall.

These quills are subject to erosion from the steam, corrosion from water while the unit is shut down, and carbonizing of oil when oil feed is excessive. Any one of these conditions could destroy the quill's atomizing ability and permit oil to merely drip down the pipe into the engine. Instead of being dispersed with the steam throughout the internal parts of the engine, the oil would be washed out the exhaust, leaving much of the cylinder wall unlubricated.

This is just what happened. When they had a chance to shut down the engine and remove the quill, they found the tip eaten away and only a stub of the tube left.

Inserting a new quill brought oil consumption down to normal without changing brands. I recommended re-examining the quill at least once every six months from then on.

3 Keep cylinder oil out of bearing oil

A paper mill was having trouble with bearing-oil emulsification in a corliss steam engine operating at 150 psi. In a paper mill, particularly where this engine was located, moisture is always present. In addition, equipment is often washed down with a hose.

With a good possibility of water getting into the steam-engine crankcase it was highly important to have a bearing oil with good water separating characteristics, or demulsibility as it is called. That was the first thing I checked. Oil they were using was pretty good in that respect. So there had to be a contaminant that affected the demulsibility and permitted water to mix with the oil.

This was a horizontal engine. On examining it more closely I found that there was no baffle or bulkhead to prevent piston-rod leakage from being thrown directly into the crankcase. Piston-rod leakage may contain both moisture and cylinder oil. The latter will seriously affect the demulsibility, color and general effectiveness of the bearing oil. This could be a cause of considerable difficulty.

Operators had trouble recently with the piston-rod packing. Because of that, the sight feed oiler to the piston-rod packing was wide open. This extra cylinder oil feed, plus steam and water leakage was draining right into the crankcase. No wonder bearing oil was emulsifying.

Without an adequate baffle it would be desirable to eliminate the piston-rod feed completely, or at least keep it to a bare minimum.

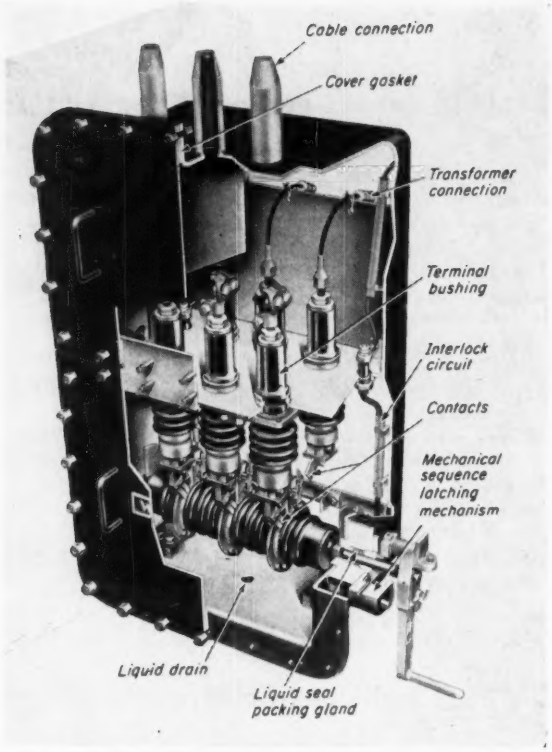
The bearing-oil condition could also be greatly improved by using a filtered straight mineral cylinder oil, instead of the compounded oil they were using.

Carrying out these suggestions cleared up the emulsification problem and made everybody happy.

Not long afterwards, I stopped at this paper mill again. The clattering of the old corliss was missing. A steam turbine had been installed and the big space the old engine had occupied for so long looked strange and unfamiliar.

By HENRY S GATES
Section Manager
Network and Power Transformer Div
Westinghouse Electric Corporation
Sharon, Pennsylvania

The switches attached to your substation transformers were built with expectation that they'd get attention similar to what you give the transformers. If you want long, trouble-free switch life, make sure that they are properly installed, intelligently operated and give accurate periodic maintenance



TYPICAL LIQUID-FILLED SWITCH cut away to show parts that require maintenance. Insulating liquid must be tested

How to maintain liquid and

► IN GENERAL, switch design matches transformer construction—both are oil-filled outdoor or dry indoor types. Exceptions include air-insulated switch assemblies with askarel units and cutouts with dry-type transformers. Modern liquid-filled switches are generally of the rotary or drum type, while those with air as the insulating medium are either link or rotary types. All require minimum maintenance. A practical maintenance schedule appears on facing page. Unusual installations or operating conditions may demand special emphasis on some maintenance items.

LIQUID SWITCHES

Rotary or drum switches have a revolving blade and porcelain unit as the principal element, usually arranged for 3-phase service. There are two positions—open and closed, or three positions — open, closed and feeder-grounded. The drum may be one-piece porcelain or made up of multiple porcelain assemblies bolted end-to-end. However, earlier switches were built with a round or rectangular paper tube as the rotating element. Most rotary switches are connected to the feeder system by cables. So, open the feeder breaker before attempting any maintenance work, except external cleaning and painting of the housing or visual inspection.

Contacts. Dependable operation of any switch requires good alignment of both moving and fixed contacts and correct contact pressure. Insufficient contact pressure will reduce current capacity and possibly cause overheating and arcing. Some switches have clamped-bolted insulators supporting the moving blades. So check bolt tightness as its important to maintain sufficient clamping action. Very light contact or misaligned contacts may carry normal load currents without trouble. But problems can be expected during transient overload and short-circuit conditions if contacts are inadequately engaged.

Make periodic checks by observation and a feeler gage to make sure contact springs have not become weakened through aging or unusual operating conditions. When feeders are out of service for regular switch inspection, check tightness of all bolted connections, alignment of moving blades, contact pressure, pothead-compound leakage.

Interlocks. Coils of magnetic contactors or solenoid interlocks should not burn out if blocked open by binding, or because latching elements do not enter the cam slots. Nevertheless, a safety device intended to prevent improper operation of the main switch blades must be checked for circuit continuity once a year. Two-step procedure is to (1) remove transformer load by opening low-voltage breakers and (2) open feeder breaker or disconnect interlock circuit to energize the interlock coil from a separate source, see sketch on next page. The separate source may be the low-voltage network bus if the transformer substation supplies power to a low-voltage network system.

Switch maintenance schedule

	Magnetizing break Oil switch			Magnetizing break Askarel switch				Load break Air-insulated switch		
	6 mo	1 yr	3 yr.	3 mo	6 mo	1 yr	3 yr	6 mo	1 yr	3 yr
Main contacts and alignment			X (4)						X	
Auxiliary contacts and alignment			X (4)				X (4)			
Main pressure			X (4)				X (4)	X		X
Drum clamp			X (4)				X (4)		X	
Shaft packing gland	X				X		X (4)			
Interlock pickup voltage & operation		X				X			X	
External mechanical interlocks	X				X			X		
Switch operation		X (5)				X (5)			X (5)	
Quick-break latching mechanism			X (4)				X (4)		X	
Case liquid leaks	X			X (1)	X (1)	X				
Internal liquid leaks		X (2)	X			X (2)	X			
Condition of liquid (color & dielectric)			X	X (1)	X (1)	X				
Condition of askarel				X						
Condition of arc chutes									X (3)	
Fuses									X	
Lightning arrester									X	

(1) After 3 months, then two 6-month periods and one-year intervals thereafter
(2) Two 1-year intervals followed by 3-year periods
(3) Check after recommended maximum limits for number of arc interruption
(4) Or check after every 200 operations
(5) Operate switch at least once per year

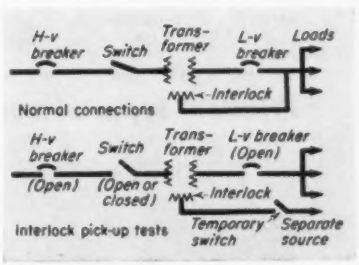
air transformer switches

Switches should be completely closed or completely open to insure proper interlock positioning.

Difficulty may sometimes be avoided by checking position of the switch handle or position indicators at each maintenance period. A switch, with a "quick-break" mechanism to permit opening of transformer magnetizing currents at full voltage, should be checked for free operation of mechanical sequency latching mechanism. The combination of electrical and mechanical interlocks will, for safety, prevent grounding of a live feeder. A check on operation of the "quick-break" contacts can frequently be made without removal of switch chamber cover. This is done by listening for operation of auxiliary switch parts. Oil the several external plungers or other types of latches with a few drops of a light machine oil at regular maintenance periods. Also examine for signs of corrosion if equipment is periodically immersed in contaminated water, even though parts are constructed of noncorrosive materials.

External Leaks. Leak observation is a vital part of all routine maintenance programs. A leak will eventually lower the liquid below the proper level. Housing cover bolts, if used with unrestrained or unretained gaskets, should be tightened ½ to 1 turn whenever a leak appears between regular maintenance inspections. Do not overdo preventive maintenance by tightening too frequently without being prepared to install a new gasket. Use gaskets cut from a good grade of cork or rubber-bonded cork (POWER, Jan 1957, pp 128, 129). When a leak occurs through retained seals, install new gaskets. Jacking screws, when provided for and not mounted on the covers, should be carried in the maintenance kit for convenient removal of cemented covers. If the switch is filled with askarel, take care to replace gaskets with a material that is resistant to nonflammable insulating liquids.

Packing glands of the mechanical compression type on switches operated frequently should be tightened periodically to prevent slight leaks. Replacement of the packing may occasionally be necessary. A slight drip of fluid after tightening does not mean the leak is still in existence. The fluid may be oozing out of the saturated packing and seepage should diminish over a period of a few days or weeks. Gland packings of neo- (Continued on page 174)



TEST HOOKUP for energizing interlocks from separate source during safety check

Plant

Electrical Fact File

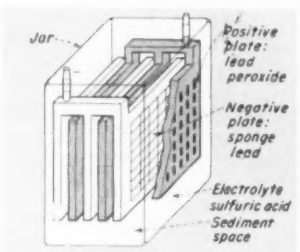
NO. 13: BATTERIES

6 tips on storage-battery care

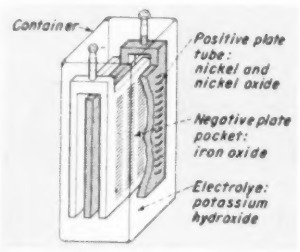
► ELECTRIC STORAGE BATTERIES provide motive power for the battalions of lift trucks moving materials and products around today's horizontal plants. They're important for standby applications too (operating switchgear, emergency light and power) and for starting diesel and gasoline engines. Good maintenance is easy; follow these 6 steps

By **NORMAN PEACH**, *Assistant Editor*

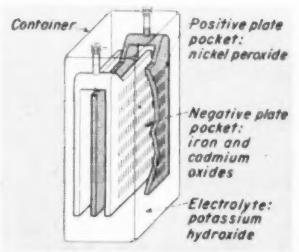
Typical industrial storage batteries...



LEAD-ACID cell has a discharge range from 2.00 to 0.02 volts. Acid electrolyte makes possible quick check on state of charge. Batteries discharge slowly if idle. Jars are hard rubber, glass, plastic

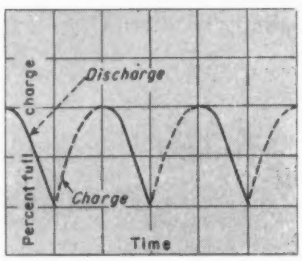

Container
Positive plate tube: nickel and nickel oxide
Negative plate pocket: iron oxide
Electrolyte: potassium hydroxide

NICKEL-IRON cells use alkaline electrolyte, have discharge range from 1.45 to 1.00 volts. Batteries use steel mechanical parts, will stand rough handling. Cells can be stored a long time with little care

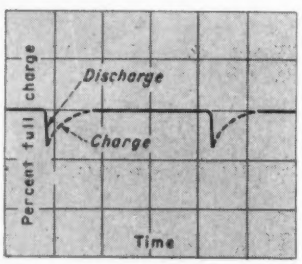

Container
Positive plate pocket: nickel peroxide
Negative plate pocket: iron and cadmium oxides
Electrolyte: potassium hydroxide

NICKEL-CADMIUM cells behave much like nickel-iron and, like them, use metal containers. Average discharge voltage is 1.2 volts. Designs are available that will function in below-zero temperature

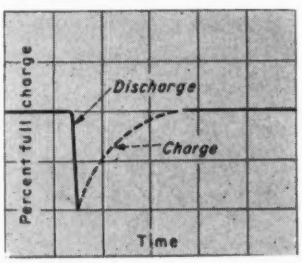
Principal types of battery duty...



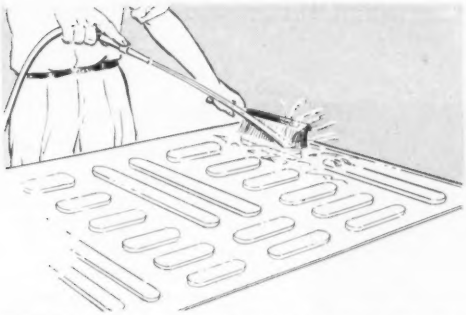
ELECTROMOTIVE duty, as in lift trucks, mine locomotives, etc, discharges battery and recharges it, usually in 24-hour period. Cycle is repeated through work week. Discharge rate varies with load



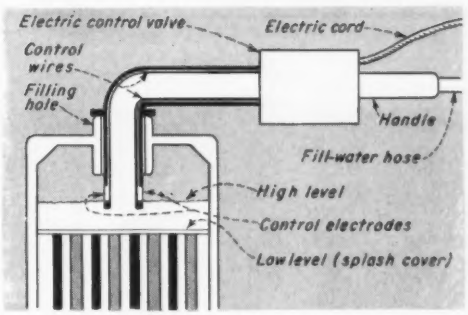
ENGINE-STARTING duty puts regular demands on battery, doesn't, as a rule, discharge it completely. Battery is recharged continuously at moderate rate while engine is running, thus keeping up charge



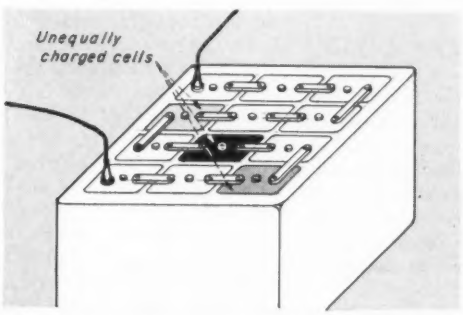
STANDBY duty keeps batteries on continuous, low-rate charge to keep them fully charged. Batteries are discharged only occasionally, power demands depending on extent of the emergency in plant



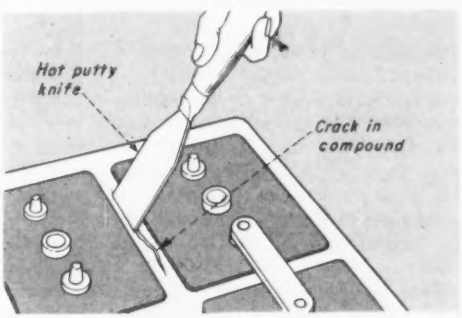
1 **CLEAN** batteries thoroughly, washing with hose and wooden-handled wire brush. Electrolyte, sprayed by gassing or spilled by hydrometer and overfilling, forms electric leakage paths between terminals. Leakage current is more important than is generally suspected. Appreciable amounts of spilled acid can be neutralized with bicarbonate of soda.



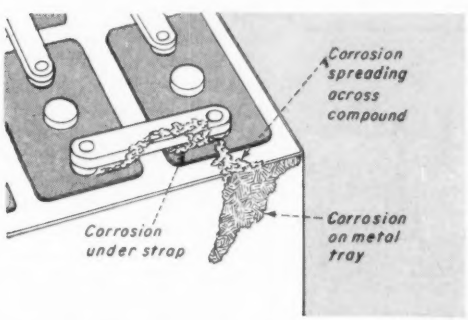
2 **ADD WATER** often enough to prevent electrolyte level falling below splash cover. Don't add too much; electrolyte may spill over during gassing. Cell filler, that cuts off water at proper level, is good investment if you have a lot of batteries. Local water is often satisfactory, but have it analyzed. Add water when cell is fully charged.



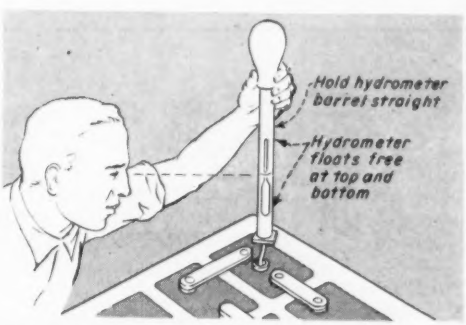
3 **EQUALIZER CHARGE** is additional charge at finish rate for 3 or 4 hours. It's important to bring all cells up to same state of charge; one low cell affects whole battery. In electromotive service, give equalizer charge once a week; at every charge if battery requires less than one charge a week. Equalize standby batteries when tests show need.



4 **CRACKS IN COMPOUND** are easily repaired and should get immediate attention. Dig out compound around crack, using a hot putty knife. Make sure all of cracked area is removed. Fill in cavity with melted compound. If cracks are not attended to, dirt and spilled electrolyte will accumulate in them creating leakage paths that cause shorts.

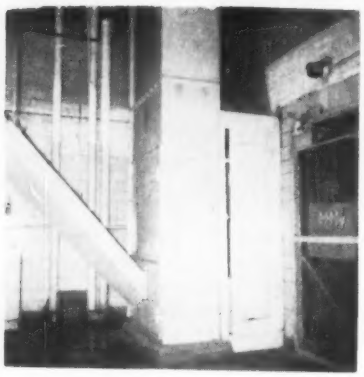


5 **STOP CORROSION** as soon as it appears. Clean terminals, straps and metal trays with wire brush. Wash with bicarbonate of soda solution to neutralize acid. Use a no-oxide grease on connections. (Lubricating oil and grease must be kept away from rubber and plastic jars.) Protect trays by coating them with the manufacturer's preparation.



6 **CHECK ELECTROYLTE** of acid cells with hydrometer. If acid is lost, overcharge and remove some liquid, replace with 1300 sulfuric acid, and overcharge to mix solution. Alkaline cells are judged by performance with load. Carbon dioxide from air affects alkaline electrolyte; replace it occasionally, following the manufacturer's recommendations.

Smart PRACTICAL IDEAS *to help you speed up your*



Here's how we get emergency coal storage

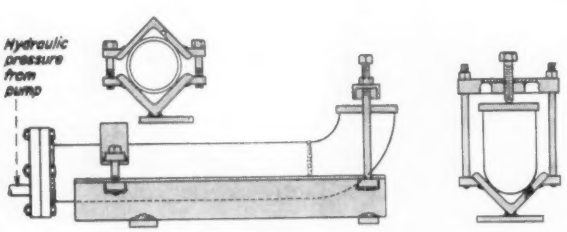
Coal handling in our plant is done as follows: Coal is dumped in outside pit over rail tracks, either by railroad car or by crane taking coal from our stock pile. Coal runs on a horizontal conveyor to a vertical bucket conveyor, then to conveyor room on top floor of boiler room to a continuous belt. There it's dumped into the 200 ton storage hoppers.

When we converted No. 1 boiler from coal to oil, we installed a chute from coal scale of No. 1 boiler to vertical conveyor. This conveyor was only a few feet away. Coal segregator was removed and a triangle-shaped outlet was installed at bottom of coal scale. A chute, installed at about a 45-degree angle, is in straight run. Coal runs into chute and conveyor by gravity.

In operation, coal scale operates as the other scales but some coal goes directly to bucket conveyor. By-pass is in open position with coal valve closed when not in use. If by-pass empties, we open valves on the other chutes from storage hopper and run a long belt to discharge coal. Hopper over No. 1 boiler is used in emergency, such as when crane is down for repair or during abnormally cool weather.

We have an extra coal supply on hand. To get it to our storage hoppers, we open coal valves and start coal-handling equipment. Access door for inspection and work on bucket conveyor is in basement, photo. Savings made in overtime labor has more than paid for material and installation cost.

A RODILISC, *Chicago, Ill.*



Fixture for pressure-testing weld of bent pipe

Some welded-pipe assemblies must be water-pressure tested. Sketch shows how flanged end can be sealed easily by a blank plate, drilled with bolt holes to match existing flange holes. Attach pipe to flange from pressure pump.

Blanking end of bend is usually a problem, unless end is flanged. But rig shown solves that trouble. Rig is handiest thing we have in our pipe shop. We wonder how we got by without it.

C T BOWER, *London Eng.*

Hold the press...

or at least we tried to, but were too late to catch an error on p 133, in our March issue. In *What would you have done?*, C Luertzing mentions a synchronous generator, when he meant an induction generator. Now we hope you've got that info straight.—*Editor*

I agree...

with E Scraggins, POWER, Oct 1956, p 188. Every plant should have a bulletin board for every boner pulled in that plant. To illustrate, after an explosion in our 150-ft chimney, the explosion came back through the breeching to the boiler, causing great damage.

Repairs were made on the 500-hp oil-fired boiler's watertubes. On day shift, a wood fire was started in the furnace to dry out repaired brickwork. Taking my shift at 4 pm, I checked water level in that boiler and assumed it to be three-quarters full. The wood fire was very light. I checked the vent, but noted no vapor escaping through the vent.

Before leaving my shift at 12:00 pm, I again checked water level but found gage glass empty. Checked again, same results. Then I started feeding water to the boiler slowly. After 10 min, water appeared in gage glass. About same time an explosion occurred in the boiler.

I kept feed pump running and hauled the fire. After cooling down, I entered the furnace and found water leaking from side of top drum. I drained the water from top drum, removed manhole cover and entered. I found the fusible plug had blown, reported same in log.

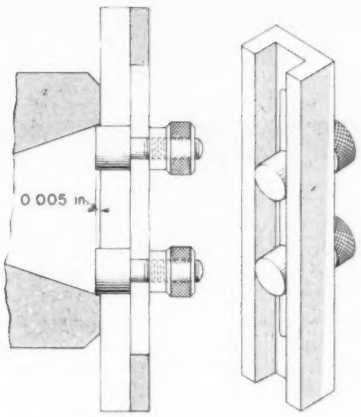
On Monday the chief questioned me again but doubted my word. I told him we could check the outside screw-and-yoke type valves, in the water columns for being open. He said the valves were showing an open position. I still maintained that I had false water-level readings, and started to dismantle the top valve. I found the valve gate had been broken from the stem, but the stem was in upward and open position. Gate had dropped to the close position, thus giving a false water level. After a hydrostatic test, we had to reroll 250 tubes.

In our present plant, we have no valves on water column. By posting every boner on our bulletin board, employees are less apt to repeat old boners.

W D DAY, *Montreal, Can.*

operation and maintenance jobs

STEVE ELONKA, *Associate Editor*

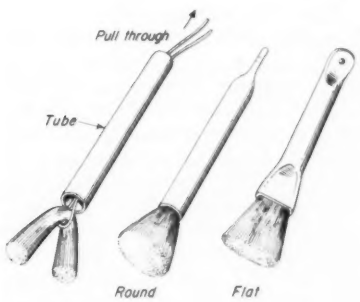


Taper bore gage

Maintenance men often need a taper gage to measure diameter at large end of taper bore. Measuring with usual tools isn't easy. With gage shown you can fix tolerance within 0.001-in.

Gage is easy to make. Make end faces of the two studs so they project 0.005-in. beyond the surface of channel piece. Finish channel piece on a surface grinder. Dimensions are unimportant, but keep 0.005-in. projection of stud end faces. Corners of studs should be sharp-edged. Studs will keep their accuracy longer if hardened. For boring tapers, first set gage with a micrometer. Then use as shown above.

C T BOWER, *London, Eng.*



Handy work brush

Next time you have some spare time, make the handy brushes shown. One of our firemen made these small bristle brushes. He used short ends of small copper tubing and bristles from worn dust brushes. Brushes are handy for soldering, cleaning, many other jobs.

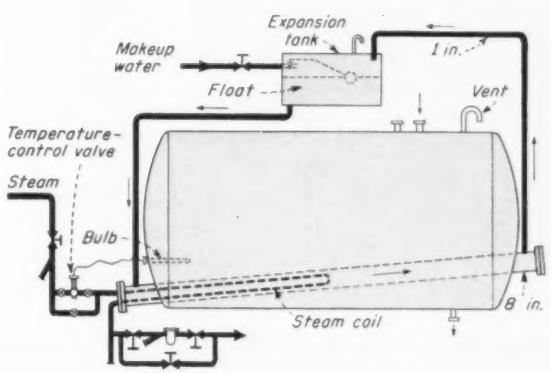
C H WILLEY, *Penacook, N.H.*

What would you have done?

I was a watch engineer and control-board operator in a municipal power plant. Boiler had 80,000 lb per hour capacity. Ten minutes after relieving the watch I discovered I had no matches or cigar lighter. Other operators were isolated and no communication system had been installed. About 30 minutes after shift change, there was a sudden load change and the pulverized-coal fires snapped out. In desperation and out of matches, the condition seemed hopeless. I did some quick thinking.

After a few seconds I opened the electromagnet coal feeder's knife switch wide enough to get a spark. With the help of a little wax paper and a spark from the knife switch, I was soon getting boiler pressure back to operating pressure. I suggest never being without a five-cent box of country matches. My solution may not have been safe practice, but what would *you* have done?

D V HARAWAY, *New Castle, Del.*



Now, this tank heats liquid without burning it

Have you ever had to store liquid in a tank where the liquid had to be kept away from the hot coils? We did. To solve our problem we made the tank in sketch, above. We could have used a tank with a hot-water jacket or hot-water coils, but didn't want to spend that much money. Besides, the heat exchanger and circulating pump needed would have added still more to cost.

Our tank is 14 ft long, 7 ft diameter, with a slanted 8-in. pipe welded through the heads. Slanted pipe has a steam coil, controlled by a temperature-controlled steam valve. This valve's bulb is stored in liquid as shown. Each end of the slanted pipe is connected to the expansion tank which has a float valve for makeup water.

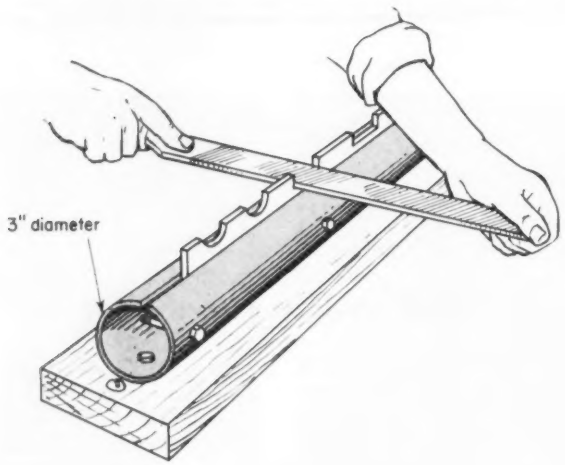
After the system is filled and steam turned on, the hot water rises to expansion tank. Then cold liquid flows down from expansion tank, giving a slow but steady circulation in the slanted pipe. Tank is insulated with 2 in. of magnesium. It solved our problem—and at a minimum expense.

A C VEEN, *New York, N.Y.*

Turn page for more Practical Ideas ►

PRACTICAL IDEAS

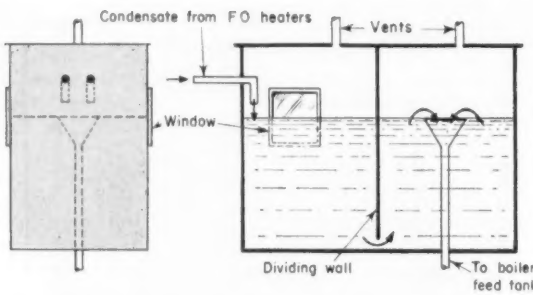
Begins on page 130



This pipe vise holds long thin strips while filing

I had to file some narrow liners into shims for a special machine. My idea was to make a long wide-jawed vise out of piping. As sketch shows, I milled a slot along the tube with a slitting saw. I could have used the slotted tube to hold the work by squeezing in a bench vise, but had better luck using several bolts. I filed strips a foot long. Pipe is mounted on a wood base and secured to the edge of our work bench.

C H Willey, *Penacook, N.H.*



Tank separates oil from fuel-oil heaters' condensate

Our plant saves condensate from fuel oil heaters. Some plants throw fuel-oil condensate away because of contamination danger.

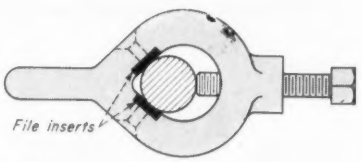
We use about 60% makeup of demineralized water, but our demineralizer cannot meet our demand. Our boiler works at 80% above rated capacity. So makeup must be as pure as possible. Because every drop of condensate is needed, we built this screening tank.

Our system has been safe now for four years. We did have three cases of fuel-oil contamination in condensate, but caught each one in time.

Condensate from fuel-oil heaters and heating coils in fuel-oil storage tanks enter the tank's first compartment. There's a big window on each side at water level, with light behind it. Operator can watch surface of condensate. Our tank holds amount of condensate normally handled in two hours. This means that if any contaminated condensate comes through when operator is elsewhere, it would take at least two hours before contamination could get through to the outlet.

Because some condensate flashes into steam when pressure is reheated in tank, tank must have two vent pipes of 2 in. dia. Vents run straight up—high enough to condense most of flash steam.

E K Nielson,
Sudamtex Colonia, Uruguay



Here's a better lathe dog for your shop

When taking heavy cuts on small work between lathe centers, driving dog often hasn't enough gripping power, allows work to slip. You can increase holding power of lathe dogs, sketch. File two recesses into inside body of dog. Cut two pieces from annealed file, hold each with a screw through tapped hole.

Reharden file pieces after sawing and fitting so they are harder than the work they will grip. Since most materials gripped in a driving dog are soft, don't harden file pieces to extent that they become brittle or they'll crack under clamping pressure against work.

T Bower, *London Eng.*

Reducing fan capacity with dampers

Experience shows that a well-made, single-louver damper or vane-control damper can reduce fan capacity by about 60%. This holds for both f-d and i-d systems. If dampers are fitted tightly into frames to improve this work, they are apt to bind with temperature changes and be impossible to operate.

Some fan makers predict capacity reduction greater than 60%. One claims he can design a special fan for 90% reduction. Considering the leeway in fans and the lower temperature of gas corresponding to lower loads on the boiler, 60% reduction in i-d fan capacity represents about 50% reduction in steam-generator capacity.

Steam generators are usually designed to operate without difficulty at less than 50% capacity. A low firing rate must be used when warming up before placing on the line. You must, therefore, provide ways for reducing fan capacity by a greater amount than usual with single sets of louver dampers or vane-control dampers. Permissible warming-up firing rate may be as low as 7% of the total heat required at the full capacity of the unit.

L V Andrews, *Worcester, Mass.*

Turn page for more Practical Ideas ▶

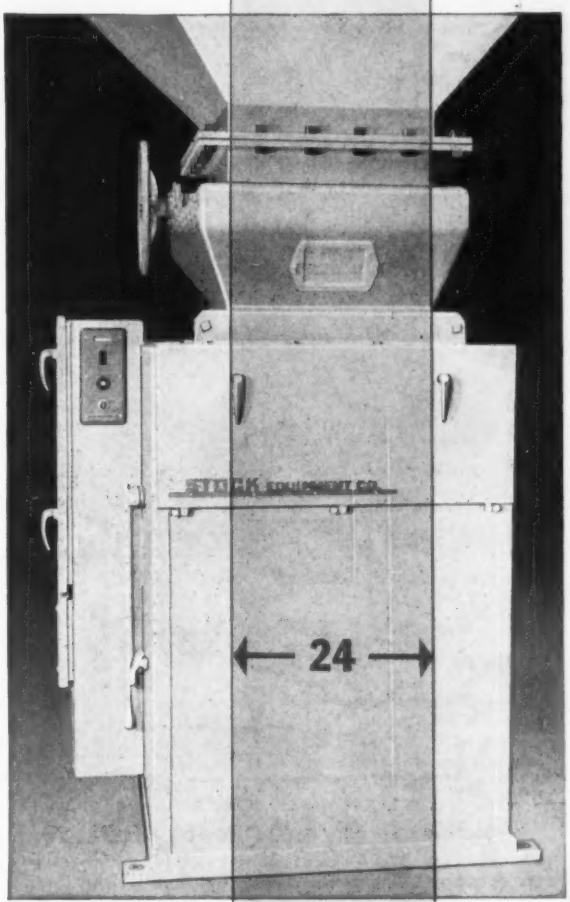
NEW S·E·CO. COAL SCALE DESIGNED SPECIFICALLY FOR LARGE CENTRAL STATIONS

Model 50 carries 24" wide stream of coal straight through without baffles, sloping skirts, or other restrictions

Modern push-button power plants burning large quantities of coal find it more desirable than ever to obtain accurate, up-to-the-minute coal weights. These weights help operators get the last BTU from each pound of coal by helping them determine boiler efficiency, keep inventory records and balance mills.

To provide these weights continually and without undue maintenance requirements, Stock Equipment Company engineers have developed the Model 50 Coal Scale. The inlet of this scale is a full 24" inside square. The extra wide feeder belt carries a stream 24" wide. The stainless steel weigh hopper has a 24" wide outlet. Because there are no restrictions or baffles inside the scale body, coal passes through easily, dependably, giving you the maximum in accuracy and trouble-free performance.

The Model 50 Coal Scale is only one of the ways in which Stock Equipment Company continues to meet the growing and changing needs of modern power plants. Years of experience in bunker to pulverizer and stoker equipment, combined with a constant attention to detail, make any S-E-Co. equipment the best you can buy for the job.



SPECIALISTS IN
BUNKER TO PULVERIZER AND
BUNKER TO STOKER EQUIPMENT

STOCK Equipment Company

745-P HANNA BLDG., CLEVELAND 15, OHIO

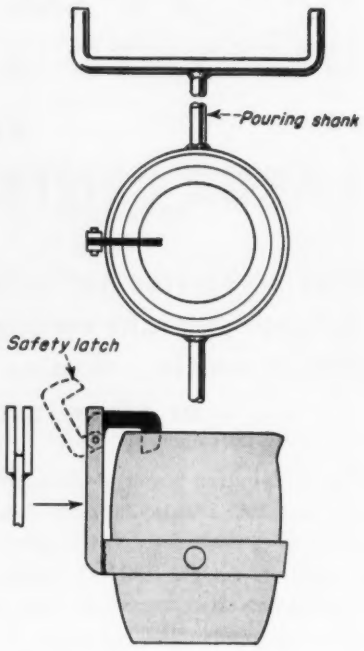
More PRACTICAL IDEAS

Begins on page 130

Radioactive cobalt takes gamma ray picture

Testing for flaws in pressure vessels with radioactive cobalt is common practice today. And industrial radiography is the second largest use of this new tool. Variety of industrial castings, fabrications and weldments are X-rayed by the radiation given off from such sources as radioactive cobalt-60 or cesium-137. For thickness around ¼ in. of steel, highly portable radiographic units using cobalt-60 are very effective, photo. Gamma radiography also has promise for the in-plant inspection of industrial equipment during overhaul. This includes motor and compressor shafts, high-speed turbine blades and other parts where cracks might lead to costly breakdowns.

—*Union Carbide & Carbon Corp*

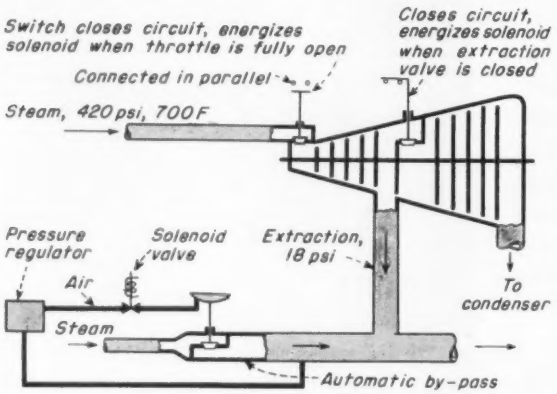


Safety latch

Sketch shows safety latch attached to pouring shank for handling crucibles from small brass furnace. But this kind of safety latch can have many other uses around plant. Latch keeps crucible in position when pouring, prevents it from splashing over side.

Crucible can be completely emptied without coming out of shank. Latch is easily made, costs little and needs no replacement. You can vary the size to suit your particular job. Safety pays off as men can work with confidence.

F T Shorten, *Sherbrooke, Que.*



Automatic by-pass keeps steam in plant line

We made a simple, inexpensive hookup to get full benefit from our turbine, sketch. This hookup is for a single automatic extraction-condensing turbine, running alone. It has an automatic by-pass to maintain steam pressure in line going to plant when there isn't enough steam from turbine for plant demand.

Our turbine operates on steam at 420 psi and 700 F. We extract steam at 18 psi. Generator is rated at 937 kva. Need for hookup shown became evident when we found that the automatic pressure regulator which controlled the extraction valves and the automatic pressure regulator which governed the by-pass valve weren't always giving the most efficient service they could produce in our plant.

We have only one turbine-generator, so we must keep it on the line continuously, 50 weeks a year. We cannot even shut down for adjustments. So we had to make the hookup shown for most efficient operation. By-pass valve cannot open unless automatic extraction valves are closed or the throttle admitting steam to turbine is wide open.

Normally you don't need the throttle connection. But we use it because we have heavy electrical and mechanical peak loads. To use by-pass when turbine is stopped we put a small manually operated switch in parallel with two other switches. It works swell.

E K Nielson,
Sudamtex Colonia, Uruguay

Do you know . . .

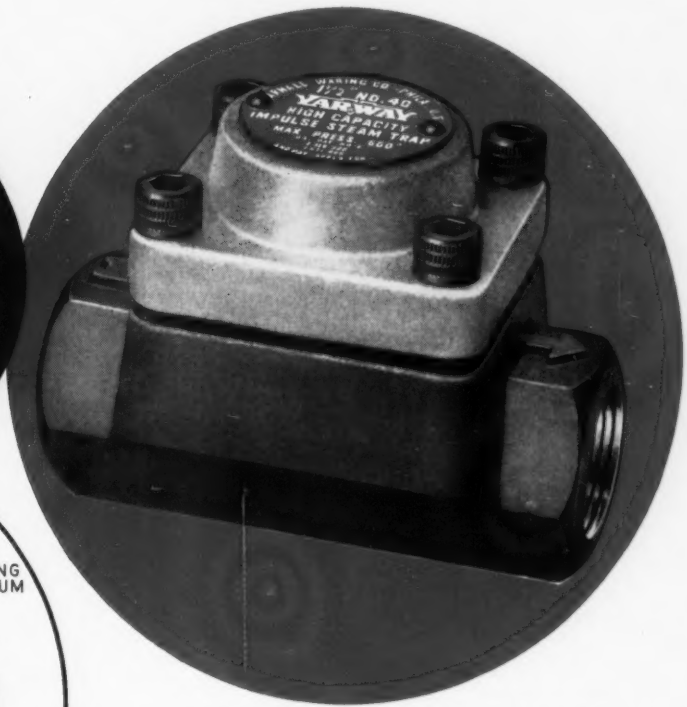
how to prevent gas explosions in your boiler? The new *Plant Operators' Manual*, McGraw-Hill Book Co, shows you six piping hookups that you must know about. Also proper meter and furnace hookups. Over 1500 illustrations and many important references for you to look up. Just off the press, get yours!

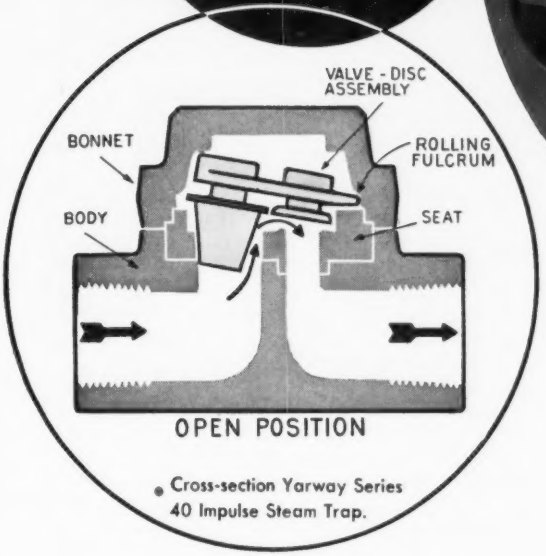
My biggest boner

Please turn to page 224

This YARWAY IMPULSE STEAM TRAP is for extra heavy condensate loads

YARWAY SERIES 40





Cross-section Yarway Series 40 Impulse Steam Trap.

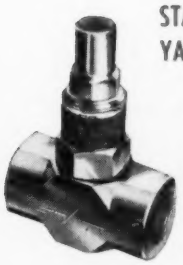
The famous Yarway "impulse" principle of thermodynamics that revolutionized steam trapping many years ago, is now applied to a steam trap for extra heavy condensate loads—the Series 40 Impulse Steam Trap. Users report with this trap they obtain quicker heating, higher and more even temperatures in their process equipment.

It also incorporates all the other advantages of earlier Impulse trap designs, such as—immediate response to load changes, no air binding, light weight and small size. Maintenance is low, thanks to stainless steel body and working parts.

High condensate capacity of Yarway Series 40 Impulse Steam Traps makes them ideal for heavy condensate loads on large autoclaves, cooking kettles, dryers, heat exchangers, heating coils, presses, unit heaters, etc.

Suitable for all pressures up to 600 lbs. maximum, without change or adjustment. Operates against back pressures up to 50%. Five sizes, ½", ¾", 1½", 2" and 2½".

Your Yarway man will furnish a Yarway "40" for 90-day free trial in your plant without obligation, or write for Yarway Bulletin T-1746.



STANDARD SERIES 60 YARWAY IMPULSE TRAP

For normal steam trap applications the standard Series 60 Yarway Impulse Steam Trap is recommended. For *extra light* condensate loads use the Yarway 20-A Impulse Steam Trap.

Both are described in Yarway Bulletin T-1739X.

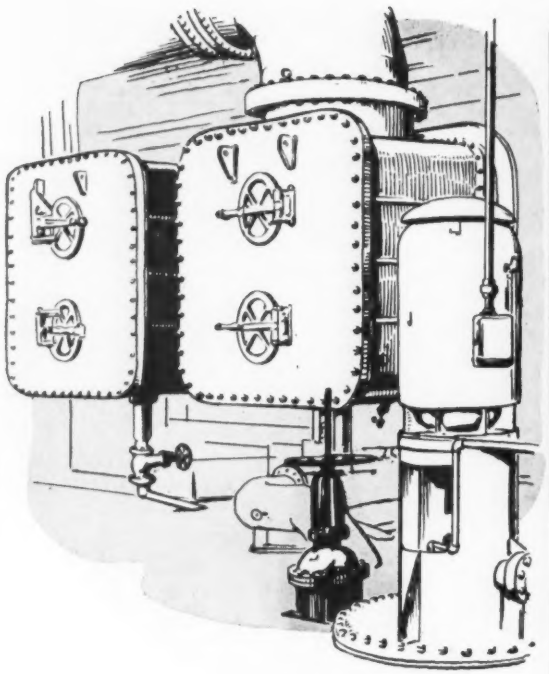
YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.

YARWAY

IMPULSE® STEAM TRAP

OVER 1,000,000 YARWAY IMPULSE STEAM TRAPS USED

Have a PLANT PROBLEM? *Tap the*



The problem

Why doesn't surface condenser maintain high vacuum?

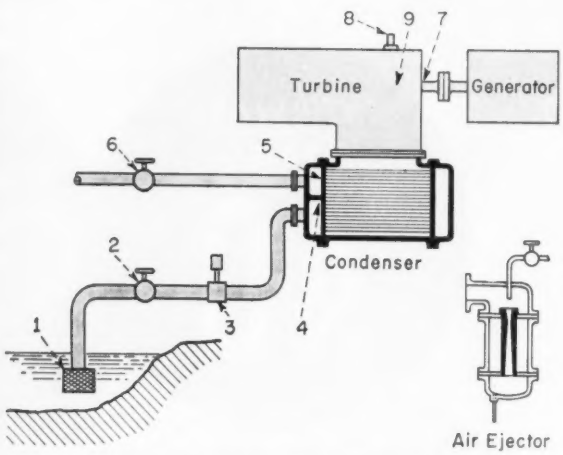
I'm chief engineer of a municipal power plant that generates electrical power from two 5000-kw condensing turbine-generators. Both of these units have been in service almost ten years. And, until recently, we haven't had a bit of trouble with either one of them.

We normally expect the condensers to pull between 28 and 29-in. Hg vacuum. Both units are equipped with steam-jet air ejection. Cooling water is from a river along which the powerhouse is built.

About a month ago we noticed that one of the condensers could do no better than 27-in. Hg vacuum. And the condition appears to be getting worse. Naturally, this cuts down on machine output—a situation we can ill afford.

Have readers had similar experiences? How have they solved the problem?—*KDG, January Power*

The solutions



Here's a 12-point check list

When a loss of vacuum occurs, I believe in checking these points:

Circulating-water system. (1) Examine the inlet suction strainer for fouling. (2) Check the suction valve and suction pressure. (3) Check speed and pressure of the circulating pump. Also look for impeller erosion. (4) Inspect the condenser-door division plate for leakage or corrosion causing by-passing. Records of inlet and outlet temperatures are an important clue. (5) Inspect condenser-tube plate for fouling. (6) Check the discharge valve.

Steam side. (7) The low-pressure gland may be leaking. Check gland steam-pressure records. (8) Examine low-pressure casing relief valve for tightness. (9) Last rows of blading may be badly eroded.

Atmospheric side. (10) Check all connections to the vacuum side with soapy lather. Use shellac to seal the small ones where doubtful.

Air ejector. (11) Check steam-valve pressure. See if jet pipe is aligned right. (12) Inspect steam nozzle for erosion. A rundown of this list should reveal your trouble.

R F HAWKINS, *Montreal, Canada*

Run heat balance on system

I would suggest that *KDG* run a heat balance around the system and determine the overall U (heat transfer) rate from:

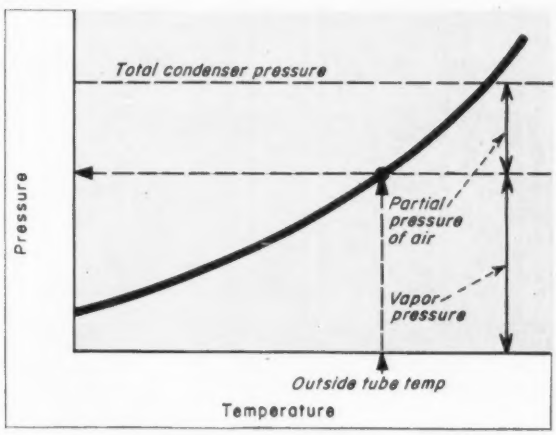
$Q = UA(dT_m)$, where Q = heat load (Btu per hr); U = overall heat-transfer coefficient (Btu per hr per sq ft per deg F); A = heat transfer area (sq ft); dT_m = log mean temp difference.

A comparison of this Q with the design value will tell whether or not the unit is overloaded. Comparing the calculated U with the design U will indicate fouling, either on the tube side or shell side of the condenser.

R E DRISCOLL, *Channelview, Texas*

know-how of over 45,000 Power readers

HOWARD KALLEN, *Associate Editor*



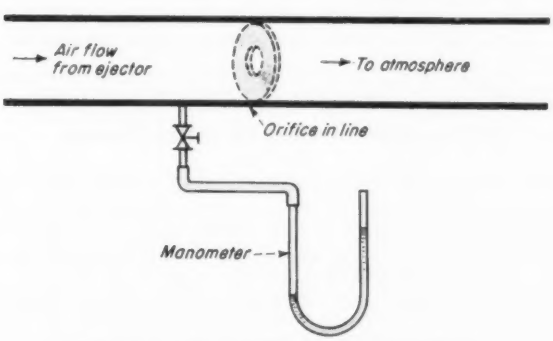
Deposits, leakage spell trouble

The principal causes behind the inability of a surface condenser to maintain vacuum are entrapped air and the formation of insulating materials in the tubes. The effect of these can be seen in the P-T diagram, above, for saturated water.

The presence of air in the condenser shell adds to the partial pressure of the water vapor. This partial pressure is established by outside-tube-surface temperature. The formation of an insulating material on the tube's internal surface presents an additional thermal resistance. *Result:* A higher outside-tube-surface temperature is required for heat transmission.

The shell may have developed air leaks that are excessive for the steam-jet air ejectors. A good method for detecting these during outages is by the use of a fire-resistant nontoxic fog. See POWER, January 1957, page 114.

R S THURSTON, *New York, N. Y.*



KDG should inspect air ejectors, circulating water pumps

It looks like *KDG's* trouble lies in his air ejectors or circulating-water pumps. First, he should make certain his air ejector is in good operating condition by checking to see that (1) design steam pressure is being maintained at ejector nozzles (2) inter- and after-condenser tubes are clean. If these tubes can't be inspected, he can check cooling-water temperature rise through the inter- and after-condenser and compare it with the other unit (assuming the ejectors are similar).

If air ejectors are not equipped with air displacement meters to indicate the amount of air infiltration to the surface condensers, *KDG* can make his own meter by tapping a ⅛-in. pipe nipple into his ejector air discharge line and connecting a manometer. It should be able to measure about 18 in. of water. Place an orifice in the line, sketch lower left, to produce enough pressure for measurement on the manometer. Be sure to size the orifice so it doesn't produce more than 18 in. of water, to avoid possible hydraulic breakdown of the steam jet. To calibrate the orifice, *KDG* can use this common formula:

Velocity $= (2gh)^{½}$, where h = static pressure read on the manometer converted from inches of water to feet of air; g = gravity constant.

If the above method indicates only the normal amount of air leakage into the condenser, the circulating pump should be checked. If the two generating units are similar, *KDG* can install pressure gages at the circulating pump discharge for each unit and take comparative readings. A lower pressure on the faulty unit would indicate need for circulating-pump repair. A higher pressure on the faulty unit would point up an obstruction between the pump and condenser discharge line.

One last point: If *KDG* is chlorinating his circulating water he should make certain that uniform distribution of chlorine is being maintained to each unit. A visual inspection of condenser tubes would confirm this. I've seen identical surface condensers that, because of poor chlorine distribution, they did not produce the same vacuum.

J L WISE, *Reading, Pa.*

Air leakage is probable culprit

Since only one of the two condensers is affected, air leakage is the probable cause of trouble. But dirty watersides, defective air ejectors and too little cooling water can also cause low vacuum and shouldn't be overlooked.

If air leakage is causing the trouble, condensate will pick up some of this air. If a deaerator is used in the system, a comparison of dissolved oxygen in condensate with the boiler feed can furnish confirmation, especially since *KDG* has a properly operating condenser for reference. I don't know of anyone who enjoys running a Winkler test, but a good diagnosis of this kind before shutting down the unit can be a big help in programming needed maintenance work.

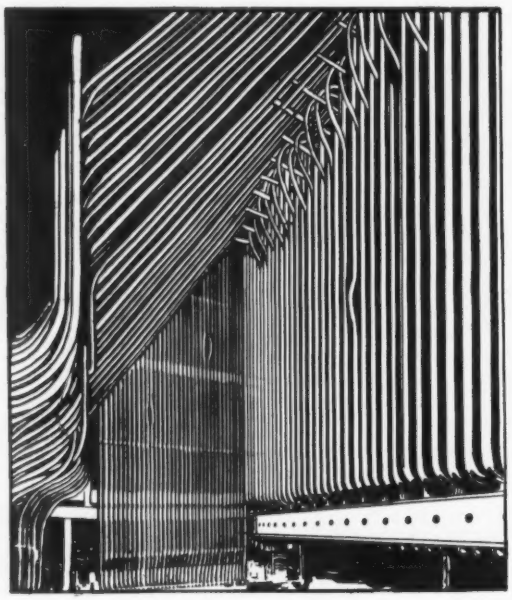
A R PECK, *Dayton, Ohio*

Want help with your plant problems? Send your design and operating headaches to us. We'll give Power readers a whack at them.

Turn page for info on refractory walls ►

More PLANT PROBLEMS

Begins on page 136



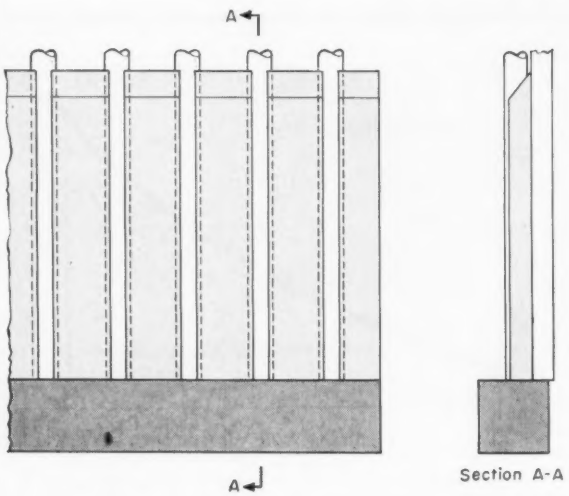
The problem

What are pros and cons of a protective refractory wall?

I would like to know the advantages and disadvantages of a protective refractory wall on the fireside of the water wall. The protective wall would be just high enough to stop the carbon soot emission caused by temperature difference when flame strikes the water wall.

We operate under a strict smoke emission law in our city. Thus, we must use excess air to eliminate smoke. If we could do the same job by using the fire protected wall, I believe we could reduce the excess air, raise the CO_2 and get better efficiency. Would this soot cause slagging in the superheater tubes? I would appreciate opinions since we're considering a protective wall.—*EEC, January Power*

The solutions



How to build refractory wall

By placing refractory material to a height of three feet above the grate on the side waterwalls, *EEC* can keep his smoke at a minimum. This shielding height will improve operation over a wide load range and, at the same time will not cause excessive slagging at high loads.

By setting a form against the furnace side of the tubes and pouring in the refractory material, about 50% of the black surface is eliminated and the increased temperature needed in the burning area is produced.

The tubes themselves are a perfect anchor for the refractory, sketch above. Only the smallest fillet on the furnace side of each tube will break off after the form is removed. The remainder, being cooled by the embedded tubes, will last a long time.

The height *EEC* indicates is fine for general service. If, however, he operates at nominal loads and seldom at peaks he may find it advantageous to increase the height.

O ERCEGOVAC, *Berwyn, Ill.*

Try a cement wash on boiler tubes

This unit appears to be a conventional oil burner. Assuming that (1) oil burner is working right and tips have been engineered correctly for flame propagation (2) oil temperature is correct for atomization and (3) flame impingement on the sidewall is not injurious, I would advise a cement wash on the boiler tubes. This would give *EEC* a relatively hotter furnace.

He can take any standard brand of refractory cement, mix it to a thin consistency and paint the tubes with a whitewash brush. This takes very little time and is surprisingly effective in increasing furnace temperature. Only drawback is the necessary renewal when cement eventually spalls and falls off.

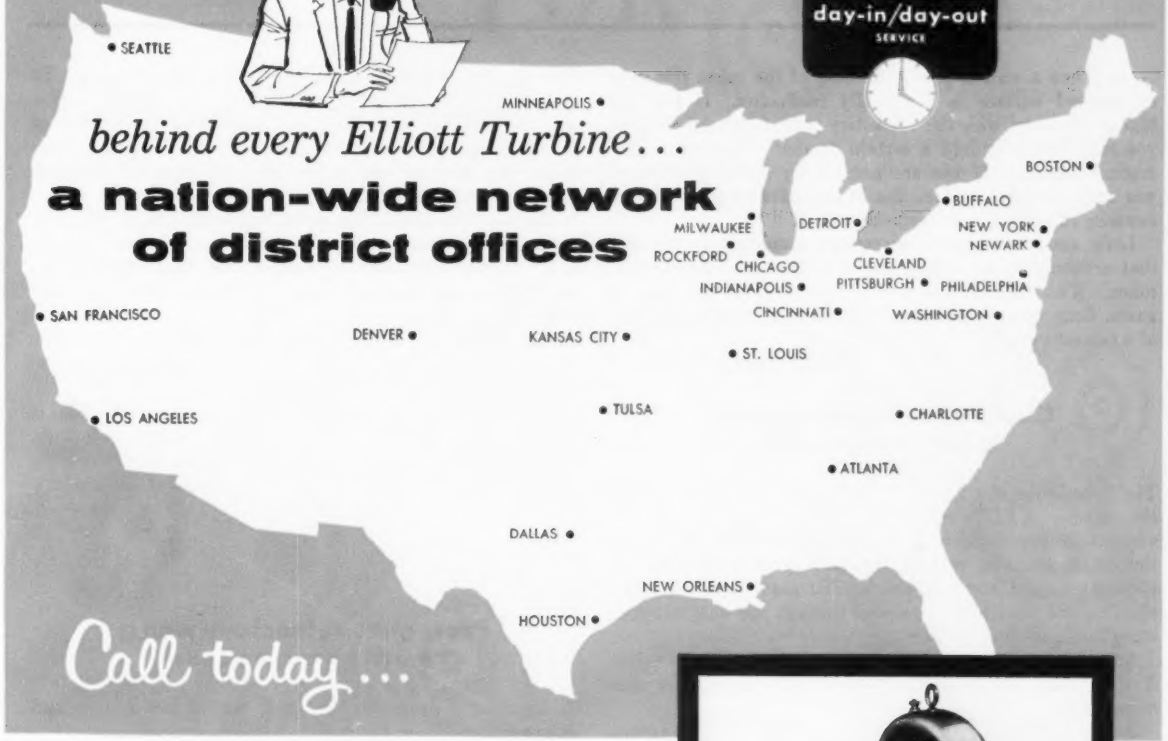
A boiler is rated on the basis of surface exposed to the

For more on refractory walls and new questions, turn page ▶

TURBINES FOR DEPENDABLE
day-in/day-out
SERVICE

behind every Elliott Turbine...

a nation-wide network of district offices



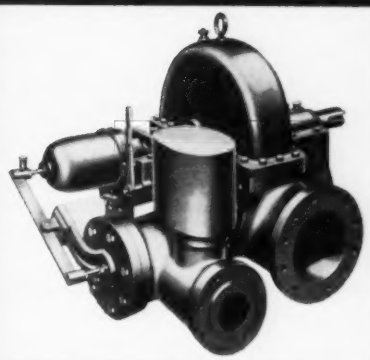
for application engineering

for operating recommendations

for maintenance service

You don't have to wait several days or even weeks for a delayed mail reply or for a turbine service engineer from a distant head office. Near every Elliott turbine installation—and thousands of Elliott turbines are in operation in process industries everywhere—you'll find an Elliott District Office providing *prompt, fast and efficient service.* Time-consuming red tape and complicated approval systems are strictly taboo.

the Elliott man in the Elliott district office is thoroughly trained to furnish designing specifications, application data, and complete costs on Elliott turbines, from the smallest single-stage to large multi-stage types. He is an engineering expert, fully capable of diagnosing your operating difficulties and of planning an effective maintenance program. Call him today.



The Elliott "Planned Maintenance" Program eliminates need for large costly inventories

Since YR turbine wearing parts are completely interchangeable, a stock of spares for each turbine is unnecessary. The Elliott field engineer will help you analyze minimum replacement requirements. Ask him for Bulletin H-23, or if you prefer, write Elliott Company, Steam Turbine Department, Jeannette, Pa.

M7-4

ELLIOTT Company

Steam Turbines • Motors • Generators • Deaerating Heaters • Ejectors • Condensers • Centrifugal Compressors • Turbochargers • Tube Cleaners • Strainers

heat. When a wall is placed in front of the tubes this area of exposed surface is practically ineffective. If you get higher efficiency with the refractory wall (and you should) you will have sacrificed a certain amount of the steam-generating capacity. If you are pressed for steam production, you may get into trouble. But if you have plenty of boiler capacity this will not be a consideration.

Let's assume the most aggravated condition is the soot that accumulates on the sidewalls between the superheater tubes. With the refractory wall producing a hot zone of gases, little or no soot should appear after the installation of a refractory wall.

W P KEARNEY, *Ft. Lee, N. J.*

Consider disadvantages of a refractory wall

The installation of a protective refractory wall might well be the solution to *EEC's* smoke emission problem. But the disadvantages associated with it should be considered. Unless the design includes sufficient support—proper bonding and staying—the surfaces will crack. The gases then accelerate spalling and soon force a passage through the wall, deteriorating it.

Another drawback is slagging of the superheater tubes. *Result:* More slag removal problems and maybe more tube maintenance.

Smoke leaving the stack consists of finely divided carbon and soot particles which are produced when the decomposed hydrocarbons from the fuel bed fail to burn thoroughly. This condition is caused by poor mixing in the grate area or too little air to complete the combustion process.

Both of the above problems can be eliminated with overfire jets. These will improve combustion by supplying excess air and providing turbulence above the fuel bed. To choose the right jets, *EEC* must figure: (1) required excess air (2) fuel's heating value (3) amount of penetration of jet discharge (4) maximum burning rate. Knowing these items, the air jets can be designed to pass the required flow for complete combustion.

The air jets should be equally spaced across the grate width to equalize combustion conditions. Jets should be automatically controlled because during light load periods the 20% excess air that might be required for full load, would become 50 or 60%.

EEC should also check CO_2 readings with jets in service. By maintaining about 14 or 15% CO_2 he will find that excessive slagging will be eliminated.

Another factor to consider in improving combustion is coal fineness. Coal with 85% minimum through 200 mesh, aids in keeping carbon losses down, reduces required excess air. So *EEC* should take another look at his coal.

A J BREUGELMANS, *New York, N. Y.*

Protective refractory wall is mostly pros, no cons

To my mind a protective refractory wall is mostly pros and no cons.

Too much black surface under light loads often produces smoke problems, ignition losses and poor efficiency. A hot furnace under these conditions will relieve the difficulty.

EEC can do the job with a silicon-carbide waterwall block that covers a sufficient area to keep temperatures high.

E R JEFFERSON, *Syracuse, N. Y.*

Your April problems

1 Can soils rectify ac current, cause corrosion?

I ran into a particularly nasty corrosion problem recently in connection with a buried condensate line.

Condensate samples showed low carbonates and a reasonable pH. A well-recommended water treatment had been slug fed at regular intervals. The chemical feed, containing lignin and tannin, is supposed to have oxygen scavenging properties and the ability to inhibit all sorts of corrosion. But the condensate line was corroding.

An electrical engineer tipped us off to the possibility of stray ac getting into the system and causing corrosion by flowing through a film of metallic salts that act as a rectifier.

I once observed a failure of some piping buried close to the ac electrical service of a building. Failure occurred mainly in the vicinity of the electrical conduits but most people agree that ac can't cause corrosion. Could some soils be rectifiers? I would like some opinions from *Power* readers—*JSM*

2 What's best way to control f-d, i-d fans?

We are installing a 50,000-lb-per-hr boiler operating at 450 psig, 650 F, to supply process and heating steam. The unit is spreader-stoker fired.

Forced-draft and induced-draft fans for this unit will be motor-driven. But we haven't decided on the best way to control them. We're considering vane, damper, hydraulic coupling, magnetic coupling and speed control. Have *Power* readers had experiences with these types? Which is preferred for a unit like ours? Load swings on this boiler will be considerable.—*HHV*

Sit down right now and answer one or both problems. We'll pay extra for answers with photos or sketches.

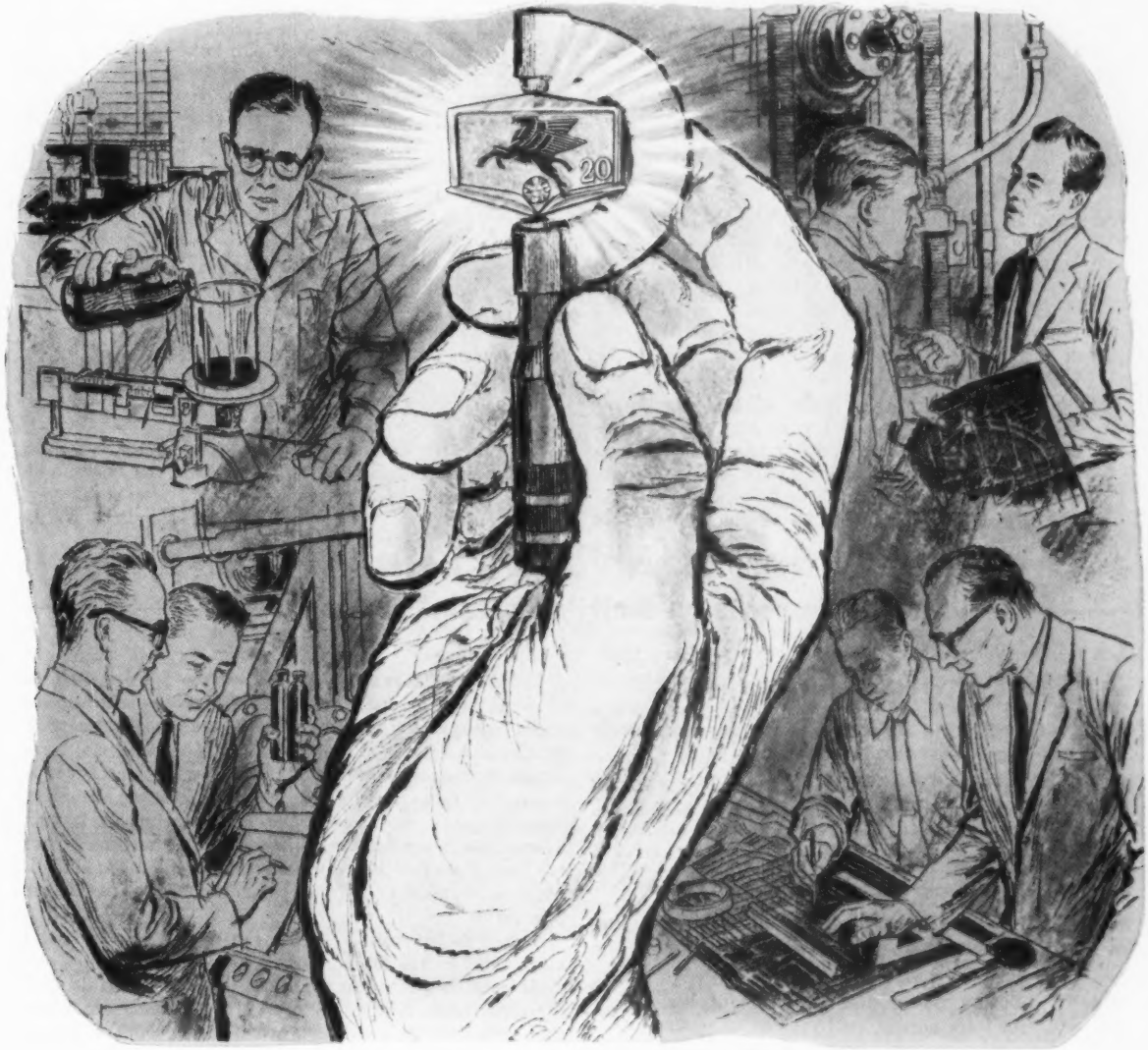
MEASURE OF A MAN

Technically, this jeweled lapel pin measures a mere 0.370 inches. But, in terms of what it represents it is the measure of a man—his depth and breadth of experience, his ability to help you.

The man is your Socony Mobil representative. The pin represents twenty years of service. Almost half of our lubrication engineers and salesmen wear it. In fact, the average length of service of *all* Socony Mobil representatives is over 17 years.

This great background of practical experience, coupled with the most comprehensive lubrication program ever offered by any petroleum company, is yours when you depend on Mobil products.

This combination has resulted in improved production, reduced maintenance costs for thousands of industrial plants. Why not yours?



Leader in lubrication for 91 years

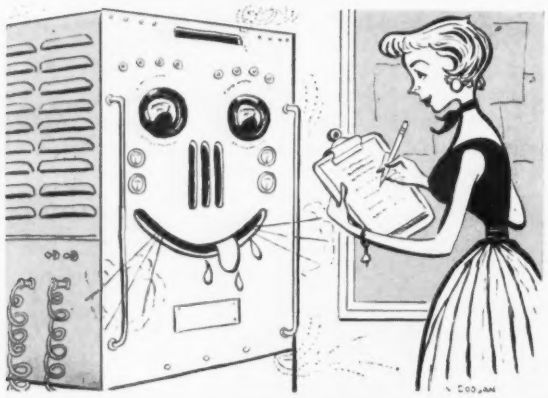
SOCONY MOBIL Mobil *Correct Lubrication*

A proved program to reduce maintenance costs

SOCONY MOBIL OIL COMPANY, INC., and Affiliates: MAGNOLIA PETROLEUM CO., GENERAL PETROLEUM CORP., MOBIL OVERSEAS OIL CO., INC.

ARGUMENTS . . . *let other readers know your views*

ALTHEA THORNTON, *Assistant Editor*



Women in power plants? Why not?

Why aren't women employed in power plants? Women can hold down the same jobs that seem to be exclusively for men—and often they can do them better. I have an engineer's degree, but must work over a drawing board because I'm not a man. Yet I've always wanted the chance to work my way up to chief engineer in a large power plant.

I understand that Russian ships sign on women as chief engineers and even captains. And many women have been successful welders, crane operators, machinists, etc. These are traditionally men's fields. The point I'm making is that ability should be the prime concern in choosing personnel. Sex shouldn't count.

Does any reader know of a central station that accepts women shift operators? Any woman with an engineering degree should be able to man a control station just as well as her male counterparts.

STEPHANIE MICHAELS, *Chicago, Ill.*

Vibration effects are negligible

In January *Arguments*, G A Rostoff says he believes telescope-mirror alignment for turbine bearings will be inaccurate. He thinks vibration will be transmitted from the turbine-generator to the floor plates.

Usually, turbine-generator pedestals are isolated from building floors, walls and other structural members, just to prevent transmitting vibrations to the surroundings. If the telescope is far enough away from bearing pedestal, vibrations won't affect it.

H B WAYNE, *Woodhaven, N. Y.*

Data sheet figures too high

The *Data Sheet* in POWER, July 1956, p 103, showed **water-pipe sizes based on the** Williams and Hazen formula. Values given are about 30 to 100% greater than those in the latest edition of the Hydraulic Institute's book *Pipe Friction.*

Anyone who is not familiar with the Hydraulic Institute's publications should contact the Institute at 122 East 42nd Street, New York 17, New York.

GEORGE SOETE, *Harrison, N. J.*

More comments on Smitt's "burned" boiler metal

Effect of temperature on metal

Over 2200 F	Steel burns or oxidizes. Look for black oxide crust on the fireside of the metal
1000 to 2200 F	Grain growth occurs. Metallographic inspection shows spheroidization along the grain boundaries. Ductility increases
650 to 1000 F	Soot burns off. Steel assumes a bluish hue; tensile strength gradually decreases
400 to 650 F	"Blue-brittleness" range. Cold working or forming at room temperature may cause brittle cracking
–20 to 400 F	Tensile and ductile properties of low carbon steel are normal

To fully answer Smitt's question, POWER, Nov 1956, p 144, you must accurately evaluate the difference between overheating and burning the boiler metal.

A burned boiler part has been overheated to a damaging extent. Metal is lost through high temperature oxidation. And there is structural damage and loss of strength.

On the other hand, a boiler may be overheated to a lesser degree without such damage. Distortion and leakage from tube joints or riveted seams may result.

Chart, left, illustrates what happens on the fire surfaces of boiler steel as metal temperature rises beyond the safe limits of about 600 F. Note that these are actual metal temperatures. A coating of soot and a "gas film" may make the actual impact temperature higher. Compare, under a microscope, the grain structure of a specimen from the suspected zone against a specimen of the same boiler part located where serious overheating is impossible. If suspected part has been damaged, there will be grain growth and spheroidization — formation of tiny globules along the grain boundaries.

Burned boiler steel is always characterized by a brittle black crust on the fire surfaces. In superficial burning, the oxide crust is paper thin; damage is not appreciable. But if crust is much thicker, say over 1/16 in., damage is probably important. In any event, a competent boiler inspector should check the unit before it is returned to service.

H M SPRING, JR, *Anchorage, Alaska*

What is the general appearance of the "burned" metal? Cherry red is not conducive to long life, but shouldn't do any material damage, nor lessen safety factor. My experience shows that no rule is iron clad. If metal appears OK, go ahead and use it.

C G HOWARTER, *Canton, Ill.*

About the Cost of Living . . . with Steam Traps

WHEN YOU specify steam traps, what could possibly be more important than *the cost of living with them*—production cost . . . steam cost . . . downtime cost . . . repair cost.

No steam traps manufactured have ever provided greater equipment operating efficiency or lower trap maintenance cost than Armstrongs.

Consider the experiences of these companies:

"30% Greater Output from platen presses since installing Armstrong Traps"—rubber processor.

"$8000 Annual Fuel Saving since replacing 600 traps with Armstrong"—metal processor.

"30% Less Downtime for repairs with Armstrong Traps"—food processor.

"$25,000 Trap Maintenance Saving every year since installing 4000 Armstrong Traps"—major chemical plant.

You may well ask, "Can there really be so big a difference in steam trap performance?" The answer is: These are typical experiences of people who have compared Armstrong trap performance—not for a month or a year, but over periods of 2, 5 and even 10 years or more.

The Armstrong trap has certain fundamental advantages, including:

No Steam Loss—the valve is always water-sealed.

Large air-venting capacity—air is automatically discharged along with condensate.

Long-life parts—hardened chrome steel valve and seat—all other parts corrosion-resistant stainless. Absolutely nothing to stick, bind, clog or collapse. Not affected by ordinary dirt and scale.

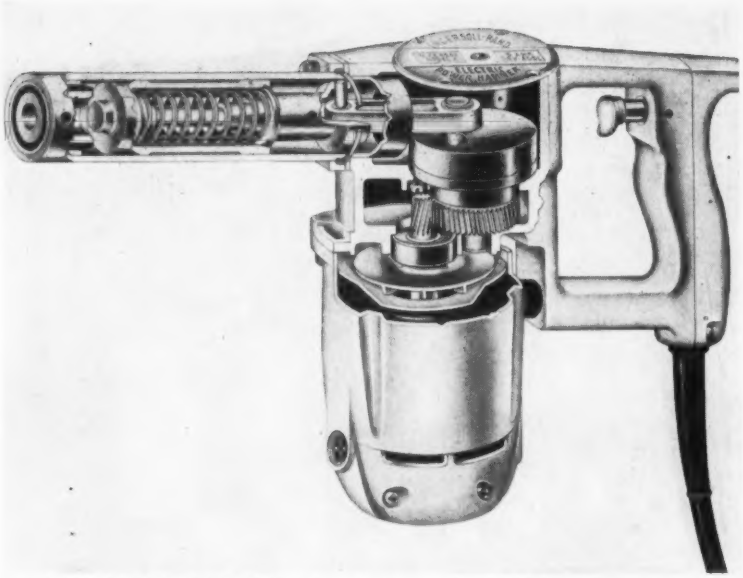
Unconditionally guaranteed to satisfy. It takes an awfully good product to carry such a guarantee.

Steam traps can have such a big effect on plant operating efficiency, they are worth more than casual consideration. Let your Armstrong Factory Representative answer your questions. There is no obligation. Call him or write:

ARMSTRONG MACHINE WORKS
8124 Maple Street • Three Rivers, Mich.

Do you have "The Steam Trap Book"?
—44 pages of useful data on trap sizing, calculation of condensate loads, installation and maintenance. Free on request.

ARMSTRONG STEAM TRAPS



SPRING-FLOATED PISTON is driven by a motor through helical gearing; crank

HOW TO use new electric hammer

► NOW YOU CAN USE this powerful new electric hammer for maintenance, construction work around your plant. For shops that don't have compressed air handy to all working areas, this tool will be especially good news.

Unit is designed for star drilling, demolishing, piercing, breaking, channeling, battering, chipping, caulking, digging, scaling, riveting, gouging, routing, hammering, roughing, chiseling, cleaning, seaming, shaping, cutting, forming, peening, tuck-pointing, scuffing, descaling and vibrating.

The tool weighs 12 lb, 13 oz. and is said to be easier to handle and to provide more power per lb than any other electric hammer. It drills holes in concrete up to 1⅛ in. diameter. Tool delivers up to 1900 blows per minute. You can use it on various materials, such as concrete, macadam, stone, cinder block, wood, metal, tile, etc.

Tool delivers solid hard-hitting blows by its spring-floated piston. A sealed spring accelerates the piston. This design is said to prevent leakage and loss of power which sometimes occurs with an air-cushioned piston.

Tool comes in standard kit, with a choice of three packaged accessory kits; or individual accessory items are supplied. Accessories include chisel blanks, scale chisels, drill adapter, drill-adapter handle sleeve, steel star drills up to 1⅛ in. diameter and carbide drills up to 1 in. diameter. All contribute toward making this new electric hammer an all-purpose tool. Tool has hardened helical gears and counter-balanced crank assembly. Nozzle is neoprene-mounted to protect the hammer when accidentally run without a tool. *Courtesy, Ingersoll-Rand Co, 11 Broadway, New York 4, N.Y.*

CAULKING large pipe joints is an easy job with this lightweight electric tool

DRILLING masonry with star-drill accessory is another common use of the tool

Organic Chemicals Division
MONSANTO CHEMICAL COMPANY
Dept. PAC-74,
800 N. 12th Blvd., St. Louis 1, Mo.

Please send me Monsanto's bulletin on Pydraul AC telling how to minimize (1) air compressor explosions and receiver fires (2) compressor maintenance due to deposits on exhaust valves and air system components.

*NAME*_____
*TITLE*_____
*FIRM*_____
*ADDRESS*_____

Want to reduce fire hazard in your air compressors?... Read Monsanto's bulletin on Pydraul AC

When flammable oil mists and films gather in your compressed air system . . . you have a real fire risk!

Ease your mind—there's a new, fire-resistant lubricant to protect your equipment, your workers and your production flow from compressor fires and explosions caused by flammable oils. Simply replace your ordinary petroleum oils with fire-resistant Pydraul AC compressor lubricant.

Pydraul AC is chemically made, not a water-soap base mixture, not a petroleum oil. It's a completely new type of bearing-protecting lubricant. Pydraul AC is created especially for air compressors. With Pydraul AC lubrication you ease your mind about compressor fires and explosions. You may also reduce maintenance costs because Pydraul AC can minimize carbon deposits on air compressor exhaust valves and air piping systems.

There's no conversion problem—just drain out the flammable lubricant and replace with fire-resistant Pydraul AC—it's that easy!

For more facts—fast: Just mail the coupon today for the new Monsanto bulletin on Pydraul AC. No cost to you. It shows properties, field experience, operating economies, etc. Act *now*. Mail coupon *today!*

There's also a fire-resistant Pydraul for every industrial hydraulic job:

- General-purpose Pydraul F-9
- Pydraul 150 and Pydraul 60 for precision equipment
- Pydraul 600 for heavy equipment

PYDRAUL: Reg. U. S. Pat. Off.

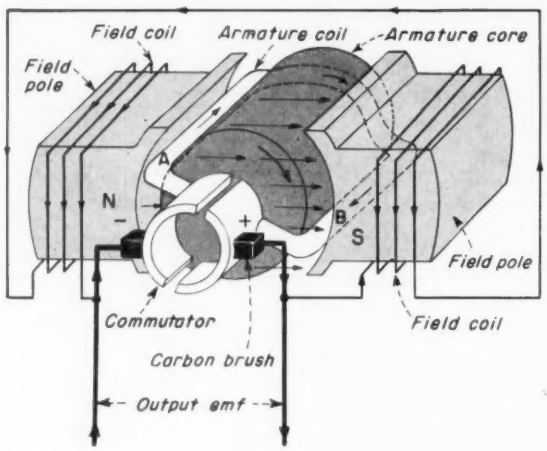
MONSANTO CHEMICAL COMPANY
Organic Chemicals Division
Dept. PAC-74, 800 N. 12th Blvd., St. Louis 1, Mo.

MONSANTO®

Where Creative Chemistry Works Wonders For You

BASICS . . . *bringing engineering theory down to earth*

NORMAN PEACH, *Assistant Editor*



Electricity: 8

What is a direct-current generator?

► DIRECT-CURRENT GENERATORS are machines that develop, at their terminals, an electromotive force (emf) that does not reverse its polarity during normal operation. Current delivered to the line by dc generators flows continuously in one direction, as does the current delivered by batteries. The dc generator has coils wound around a cylindrical core of magnetic iron or steel called the *armature*. The armature is located between magnetic *field poles* which produce a strong magnetic flux through the armature. As the armature is rotated, the coils wound upon it cut the magnetic lines of force of the field and an emf is generated in the coils in the manner described in last month's *Basics*.

Sketch, above, shows an armature with one coil of a single turn. (This is not a practical generator but is shown for the sake of simplicity.) The ends of the coil are connected to halves of a split cylinder of copper known as a *commutator*. In actual practice, since there are many coils, there will be many segments, or bars, in the commutator. The commutator turns with the armature, but is constantly in contact with the stationary *brushes*, usually made of carbon. In this way, the emf is brought to the external circuit. If the generator is part of a closed circuit, current flows through the armature coil, out of the segment in contact with the positive brush, through the external circuit, back to the negative brush and commutator segment to the coil.

The rotating coil, as it rotates in a clockwise direction, cuts lines of force in an upward direction on the left and downward on the right. The induced emfs add up and cause a current to flow according to the right-hand rule, as shown by the arrows. Coil side *A* is connected to the negative brush and coil side *B* is connected to the positive brush. When coil side *A* has reached the top and coil side *B* is at the bottom, both are moving parallel to the flux, without cutting lines of force; hence no emf is induced. At this moment, the brushes bridge the space between the commutator segments, but no short-circuit current flows because there is no emf. As the coil continues to rotate, side *A* moves down on the right while side *B* moves up on the left. The emf and current in the coil is in the *opposite direction*. Current in the external circuit continues to flow in the same direction, however, because coil side *B* is now in contact with the negative brush and coil side *A* contacts the positive brush. Thus, the commutator and brushes supply the external circuit with direct current while alternating current is being induced in the windings.

Magnitude of emf of single coil varies with its position in the field. Starting with coil sides parallel to flux (on top and bottom), emf is zero. Emf builds up until it is maximum when coils are perpendicular to flux (at center of poles), then decreases again to zero. From zero it builds up again, in opposite direction as far as internal circuit is concerned, but in the same direction in the external circuit. Such voltage variation would be undesirable in most applications. A nearly steady value of output voltage is obtained by using a large number of coils and commutator bars in series. Since the coils are distributed around the armature, the instantaneous emf of each is different. But at any instant, the sum of these emfs is a constant value.

Generator fields must be strong, so electromagnets are normally employed. They can be *excited* (supplied with current) from a separate generator (exciter) or battery, but usually they are supplied by the generator itself. When field coils are connected in parallel with the load, the generator is called a *shunt generator*. When field coils are in series with the load, it's a *series generator*. If the machine has two sets of field coils, one set shunt and the other series, the generator is said to be a *compound generator*. Each arrangement, including separate excitation, has characteristics that suit it for a particular kind of load.

Next month's Basics: Why alternating current is different

In JENKINS Monel-seated Bronze Gates

THE WEDGE TAKES THE WEAR - *and spares the rings*

Easy replacement of the wedge only — right on the line — restores full efficiency

THE MONEL SEAT RINGS are expanded into the body to assure a positive, leak-proof joint. Exhaustive tests in typical monel-seated gate valve services show that this permanent all-around support of the rings is essential to guard against deforming, loosening, or shifting.

THE RENEWABLE WEDGE (bronze or nickel alloy) has excellent wear resistance, but has a lower degree of hardness than the heat-treated Monel rings, which have optimum resistance to erosion and corrosion as well as abrasion. Thus, wear of the wedge leaves the rings relatively unaffected. When necessary to renew the wedge, you simply remove the valve bonnet, slip the old wedge off the stem, and slip on a new one.

GET PRACTICAL, LOW-COST RENEWABILITY in the valves you choose for the tough, punishing services that require Monel-seated gates. Compare . . . there is nothing simpler, faster, or more economical than Jenkins replaceable wedge design — and you also get the *plus* of Jenkins *extra value* in every other feature. Jenkins Bros., 100 Park Ave., New York 17, New York.

MADE WITH BRONZE OR NICKEL ALLOY WEDGE

The bronze wedge provides lasting economy for most applications. The nickel alloy wedge provides extra resistance where rapid wear and corrosion are factors.

JENKINS BRONZE GATES WITH MONEL SEAT RINGS

200 psi	300 psi
Fig. 270-U, Bronze Wedge	Fig. 280-U, Bronze Wedge
Fig. 270-UN, Nickel Alloy Wedge	Fig. 280-UN, Nickel Alloy Wedge
Fig. 270-UL, Bronze Wedge, U.L. approved for L.P.G. Services	350 psi Fig. 280-UX, Bronze Wedge

JENKINS BRONZE GATES INCLUDE 40 DIFFERENT PATTERNS

125 • 150 • 200 • 300 • 350 psi SOLID WEDGE • SPLIT WEDGE
SCREWED • FLANGED • SOLDER END • SOCKET END QUICK OPENING

Call your local Jenkins Valve Distributor for complete information.

JENKINS VALVES

LOOK FOR THE JENKINS DIAMOND TRADE MARK

SINCE 1864 JENKINS

Jenkins Bros

"Those wild monsters kept circling the base of my tree, snorting and clacking their ugly tusks," roared Marmaduke Surfaceblow

Marmy's big blast

► POWER receives the most interesting mail addressed to Marmaduke Surfaceblow. This letter came in today from Energia Electrica De Venezuela down in Maracaibo, Venezuela. Here it is:

Dear Mr Surfaceblow:

The engineering staff of our production department asked me to request your permission to open a local branch of the Bent Propeller Bar. Bar will be in the patio of my home, which is on a hill overlooking our plants. We would appreciate a photo, lithograph or sketch of yourself, which we will hang in a place of honor over the bar, close to the supply of Sandpaper Gin.

In the unlikely event that some guest should be so crass as to display his ignorance and ask who the old reprobate is, or how the bar got its name, we'll have the answer ready. We'll have two copies of your book chained to the bar and strangers won't be allowed the privileges of the house until they qualify by reaping at least one of your pearls of wisdom.

Please find enclosed check for $3.00 for two copies of your book and picture, plus mailing charges. Should you ever be forced to leave the U.S. and find yourself in Maracaibo, we would be very pleased to see you. Just a word of warning—Venezuela has an extradition treaty with the United States.

Yours sincerely,
George K Weir
Production Superintendent

Armed with this friendly letter, I climbed the creaky stairs to the old consultant's dingy office above O'Houlihan's Machine Shop & Engine Works. His office door was open. The crisp spring breezes blowing from the open window carried the foul-smelling tobacco smoke right into my face. The tiny office was crowded with the usual assortment of seafaring characters. Hot arguments, punctuated by raucous bursts of laughter and the slurping of coffee, were raging all over the room. But Marmy paid no attention. He was deep in thought, staring at some dirty steam-engine indicator cards scattered over his cluttered roll-top desk.

I drew a deep breath and barged bravely into that den of beachcombers. Placing Mr Weir's letter before the foxy old boy, I sat down quietly in a corner and waited. Marmy grunted, scanned the letter while puffing away on a piece of rope yarn. Suddenly he leaned back in his swivel chair, hoisted his size-16 canal boats up on his desk and roared— (*Continued on page* 184)

The Power Plant Engineer Said: "I WOULDN'T KNOW..."

INQUIRING REPORTER: So you use Nalco System water treatment ... How often are your boilers turbined?

ENGINEER: I wouldn't know—only worked here seven years.

You recognize the Engineer's answer as a twist on the old one about *How-often-do-you-get-a-raise-around-here.* Our excuse for bringing it up is that the engineer's answer applies to hundreds of plants using Nalco water treatment. New plants, starting boilers from scratch with Nalco, report years on line, *billions* of pounds of steam generated in boilers that have *never* been turbined ... and probably never will be. Older plants, where turbining was as routine as checking the draft gauges, now open boilers only to show the inspectors.

These Nalco *results* can quite possibly be duplicated in your plant, regardless of the kind or severity of your water treatment problems ... or the size of your operation. Write or phone, now, for a fast start toward permanent water treatment security.

NATIONAL ALUMINATE CORPORATION

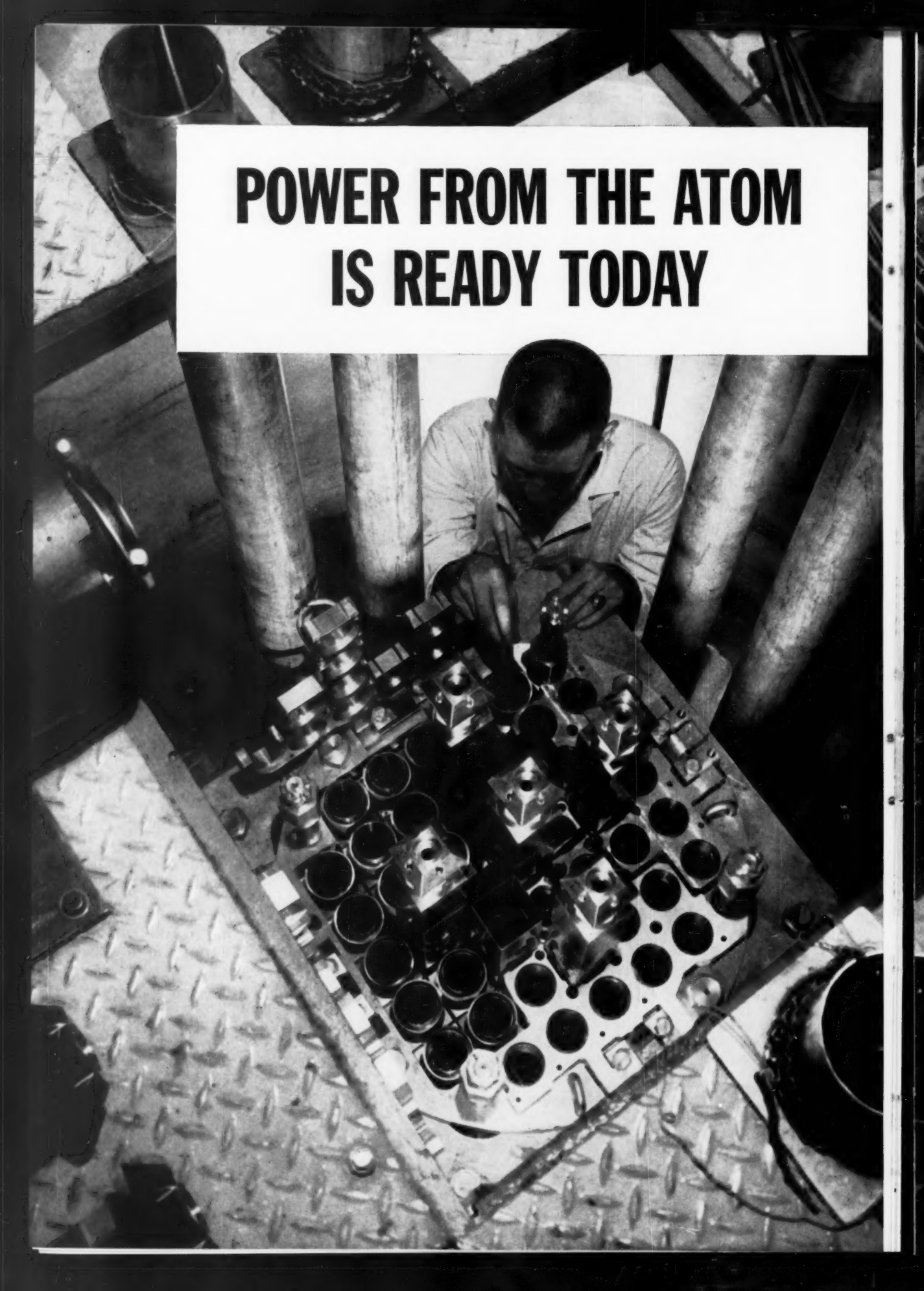
6222 West 66th Place • Chicago 38, Illinois

Telephone: POrtsmouth 7-7240

In Canada: Alchem Limited, Burlington, Ontario

THE *Nalco*®

SYSTEM ... Serving Industry through Practical Applied Science


POWER FROM THE ATOM
IS READY TODAY

ALCO's pressurized-water plant offers safe, stable power to 20,000 kw for high-cost fuel areas

Basic design and engineering for the ALCO atomic plant are complete. Experience with the Army Package Power Reactor — built by ALCO under the first fixed-price contract for a plant awarded by the AEC — has contributed to the commercial plant design. Because of this, the plant is not experimental. It can provide economical power in remote areas where fossil fuels are expensive. And ALCO's own criticality facility will make tests on specific reactors to insure their performance — before they reach the plant site.

Investigate the ALCO atomic plant. Technical analysis is available, at no obligation, on site selection, design specifics and operating costs.

ALCO nuclear components result of experience, leadership

ALCO's leadership in thermal engineering and manufacturing has produced atomic plant components for almost all reactor types. ALCO has designed and built components for the *Nautilus*, the APPR, sodium reactors and various AEC production installations. Along with this extensive experience, ALCO has complete facilities to insure continued leadership. These include its new thermal laboratory, mechanical, welding and metallurgical laboratories, criticality facility, and an electronic-computer center for thermal, mechanical and nuclear problems.

Here is a list of ALCO atomic plant components that are available:

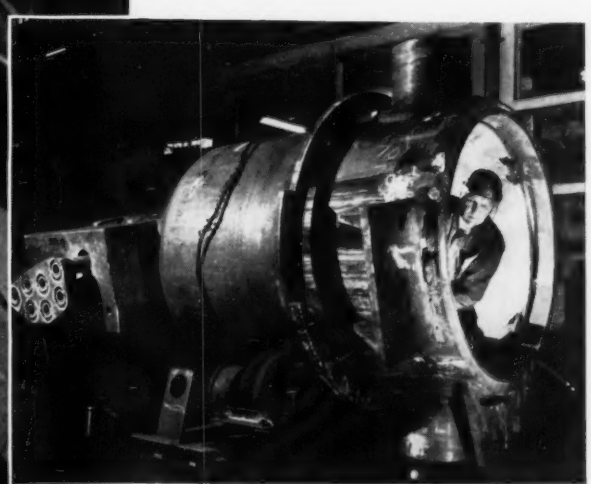
reactors • reactor vessels • control-rod drive mechanisms • steam generators pressurizers • core-support structures • core removal and handling equipment regenerative and non-regenerative exchangers • liquid metal exchangers decay exchangers • special heat-transfer equipment.

For information, including the brochure "Competitive Power from the Atom," write Atomic Projects, Dept. AE-1, P.O. Box 1065, Schenectady 1, N. Y.

ALCO

ALCO PRODUCTS, INC.
NEW YORK
Sales Offices in Principal Cities

Locomotives • Diesel Engines • Nuclear Reactors • Heat Exchangers
Springs • Steel Pipe • Forgings • Weldments • Oil-Field Equipment



Reactor vessel for APPR was built of stainless steel at ALCO's Dunkirk, N. Y. plant.

Cutaway of ALCO steam generator for pressurized-water atomic plants.

Technician checks APPR reactor core prior to tests in ALCO's criticality facility at Schenectady, N. Y.

Reader service section

Start with these quick samples...

Coming round the mountain . . .

of news releases on our desk this month, we noted several interesting items. First, there was the story of the rustic work-and-playground that industry is planning for its research men; then, the revelation that the AEC has released another product for civilian use and in so doing has cleared up a bit of a mystery. Interested? Then see . . .

Reports from the field, p 154

The little red schoolhouse . . .

sees the birth of our education. And from that day on we continue to learn. For an engineer, the learning process is less one of easy osmosis than one of constant cramming. To make the learning process a little easier, *Power* presents monthly summaries of the latest technical papers and provides the directions for obtaining the full paper.

Technical briefs, p 156

Since Hector was a pup . . .

there hasn't been anything to equal the growth that our generation has witnessed in the plant equipment field. What is new today will be obsolete tomorrow, or maybe in just a few hours. That's why it's a good idea to keep an eye on what's developing even if you're not planning to buy. For a quick look at the latest . . .

Plant equipment news, p 160

A bushel and a peck . . .

of free catalogs and bulletins are at your disposal each month when you receive your copy of *Power*. Manufacturers, anxious to acquaint you with their product or to inform you of a new process, send us dozens of these bulletins each week. We sort through them, select the ones we think you'll want most and print them for your perusal.

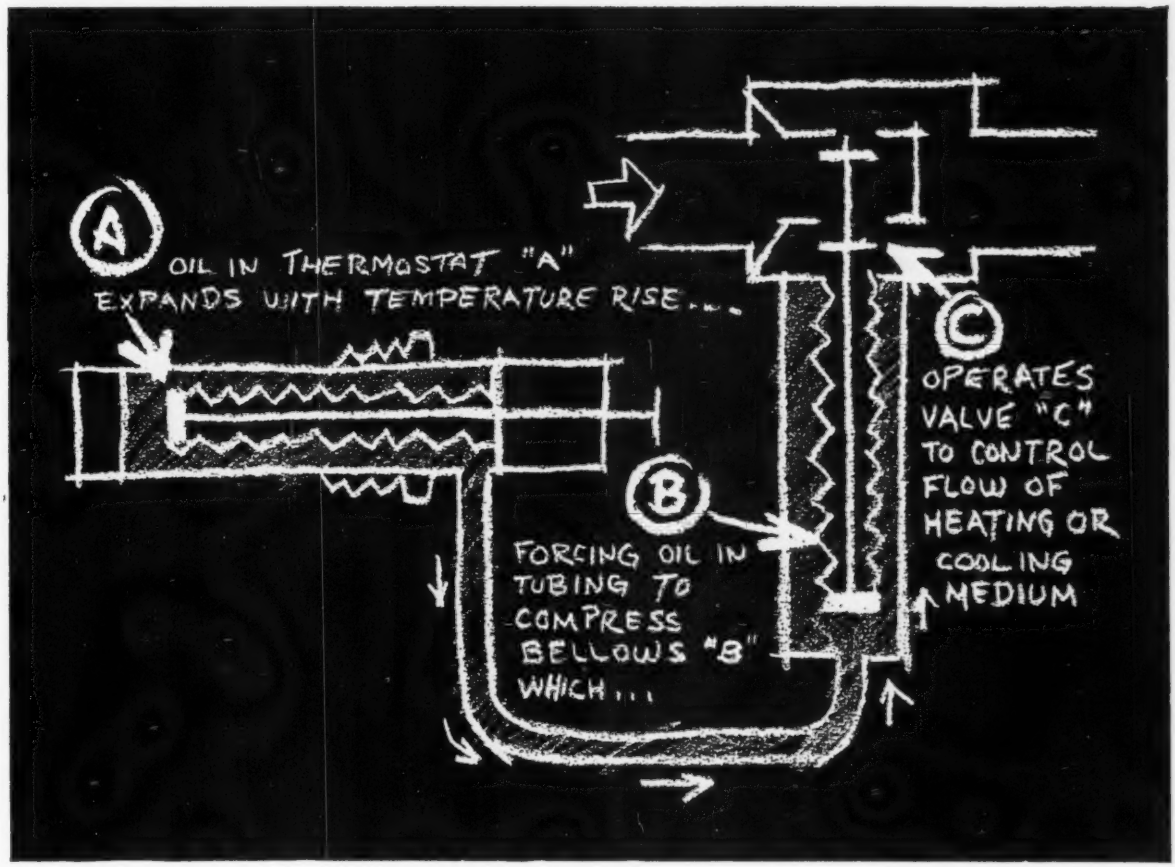
Free literature, p 169

Feuding, fussing and fighting . . .

could be greatly lessened if people would only remember these words, "Let him who is without fault cast the first stone." Nothing makes a man madder than a superior attitude. Truth to tell, few people can afford an "I'm better than you" air, for the fates seem to take a particular joy in proving them wrong. For a good example . . .

George Edwards, p 172

For other timely ideas, see following service pages ▶


A
OIL IN THERMOSTAT "A" EXPANDS WITH TEMPERATURE RISE...
B
FORCING OIL IN TUBING TO COMPRESS BELLOWS "B" WHICH...
C
OPERATES VALVE "C" TO CONTROL FLOW OF HEATING OR COOLING MEDIUM

Automatic Temperature Control

AS SIMPLE AS A-B-C !

And what could be simpler!

Just take another look at that rough sketch. That's all there is to it. A simple thermostat – a length of tubing – a valve. That's all!

That's the trouble-free design of the Sarco SELF-POWERED temperature control. And each year, thousands give accurate service in all industries ...for firms such as Colgate-Palmolive Company, Sinclair Refining Company, Swift & Company.

These temperature controls are simple, inexpensive, dependable, effective. No highfalutin gadgets that take a technician to read and a specialist to fix! Self-contained—no exposed mechanism. Packless. No outside power connections. Can be installed by any pipe-fitter.

And you'll find these temperature controls wonderful for about 85% of your jobs... all but those few specials that call for elaborate, costly control.

Cost? Mighty low! For example, the ½" size is yours for about $100. It's good economy to specify AUTOMATIC temperature control for ALL control jobs, not just the big ones.

SARCO COMPANY, INC.

Sarco Company, Inc., Empire State Bldg., New York 1, N. Y.

Please send information on your simple, inexpensive temperature controllers:

☐ Self-powered type for use on_____

☐ Electric indicating type for use on_____

Name_____

Firm_____

Address_____

City_____ State_____

2136B

REPORTS FROM THE FIELD

What's happening in power and what it means to you

For Calendar of Events see page 240

Scientists' Shangri-La Slated for N. Y.'s Sterling Forest

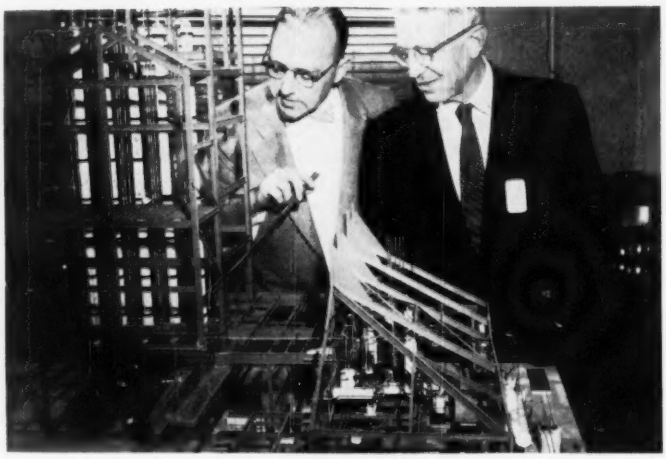
► HAVING INVOLVED modern man in a hopeless maze of gadgets and machines, our scientists and engineers are heading back to the peace of the woods.

First note of the retreat was sounded by the City Investing Co of Manhattan. City Investing has submitted plans for a science city to be located in New York's Sterling Forest. Here researchers for industry will live, work and play.

Homes, designed to fit in with the rustic landscape, as well as shopping, recreational and school facilities, will be provided for employees.

Recreation, including fishing, swimming, sailboating, skating, hiking and hunting will be provided at the lakes and in the forest areas.

First endorsement of this scientists' Shangri-La came from Union Carbide and Carbon Corp, along with the announcement that the company will build a nuclear research center there. Similar endorsement came from other segments (*Continued on page* 238)



AEC clears up mystery of Model City plant

► LESS THAN 3 LB a day of gray "gold dust" are being produced by a staff of 115 on a 3-shift a day basis at a plant 12 miles from Niagara Falls, N. Y. This announcement by the AEC spikes conjectures of those who suspected the Model City plant of processing uranium. It is now clear that the plant (shown above), run by Hooker Electrochemical Co, presents no radioactive hazard. Product, now available for civilian use, is metallic form of the isotope boron-10, with a value 3 times that of refined gold.

Power Lines

Feeling like a hen gone wrong, Norton Lab men are wondering what to do with a 10" egg they've laid. Client ordered a 1.0" dia heat exchange sphere. Somehow the decimal got lost in the shuffle; now Norton's holding the bag.

Following through on AFL-CIO plans to organize white collar workers, the UAW has begun recruiting engineers, scientists, craftsmen and technicians from the aviation industry. Name of the new union: Aircraft and Avionics Engineering Council.

National Committee on Radiation Protection has cut by 1/3 the maximum permissible dose of radiation for humans, according to National Bureau of Standards.

Televised phone calls are possible in 2 or 3 years according to General Electric spokesmen. Timid souls have a new worry—what to do about bath-time calls.

London—(McGraw-Hill World News)—Long-rumored troubles at Calder Hall confirmed by Sir Christopher Hinton. British, however, claim cure for bursting fuel elements; have high hopes for CH type of reactor.

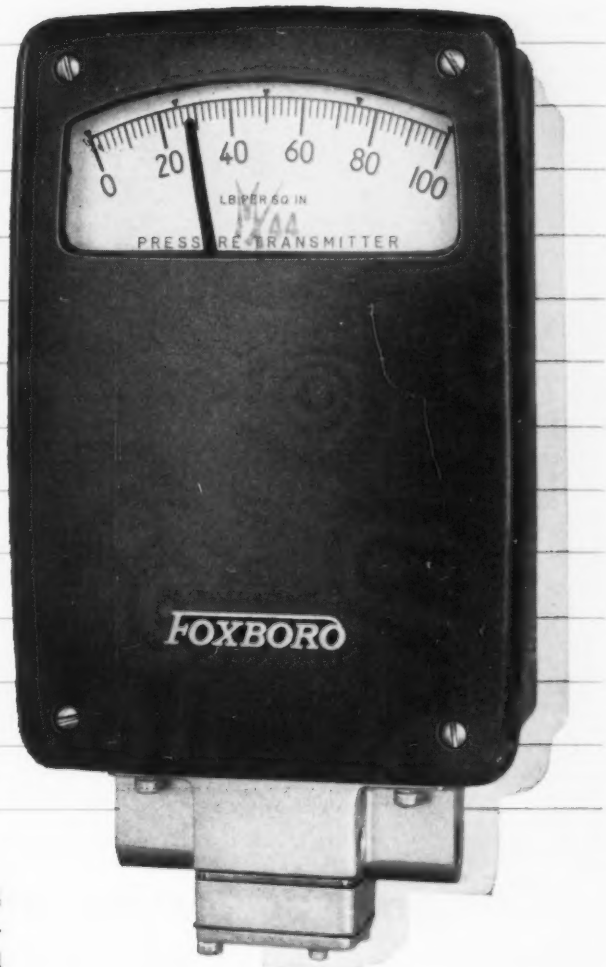
Citing a "tremendous upsurge" in power generating equipment field, GE pooh-poohed the prophets of doom; predicted a good business year for the nation.

Power transistors, capable of switching a load in excess of 1 kw are in mass production at Delco Radio Div of General Motors. Believed to be the first production transistor capable of switching such power.

These are three of the first experimental gas-filled power circuit breakers built. Developed by Westinghouse, 115-kv, 100-mva breakers are installed on Gulf Power Co substation, Pensacola, Fla, to get performance data.

Unique combination of fine engineering and economy!

...the new FOXBORO M/44 INDICATING PRESSURE TRANSMITTER



- **Easier to Read . . . large indicator scale, visible at 20 ft.**
- **Easier to Calibrate . . . simple adjustments "on location"**
- **More Compact . . . single, integral instrument**

Any way you look at it, the new Foxboro M/44 Pneumatic Pressure Transmitter gives you an unmatched combination of fine engineering and economy. First; because it *is* an engineered instrument. There are no attachments or "makeshifts". Second; because it utilizes standard Foxboro parts throughout—parts which have been performance-proved in thousands of successful installations of other Foxboro Instruments. And this means not only top performance, but easier servicing and stocking as well. Third; calibration is simple, right in the field, because the M/44 is "convenience-designed" by men with years of experience in every phase of instrument design and application.

In appearance, too, the M/44 has unmistakable Foxboro quality. Features like the high-legibility indicator scale, the compact drawn-steel case with tough polyester plastic cover. It's the neat, high-efficiency, low-cost pressure transmitter for centralized operation or control. All standard ranges.

Write for complete details

THE FOXBORO COMPANY
684 Neponset Ave., Foxboro, Mass.

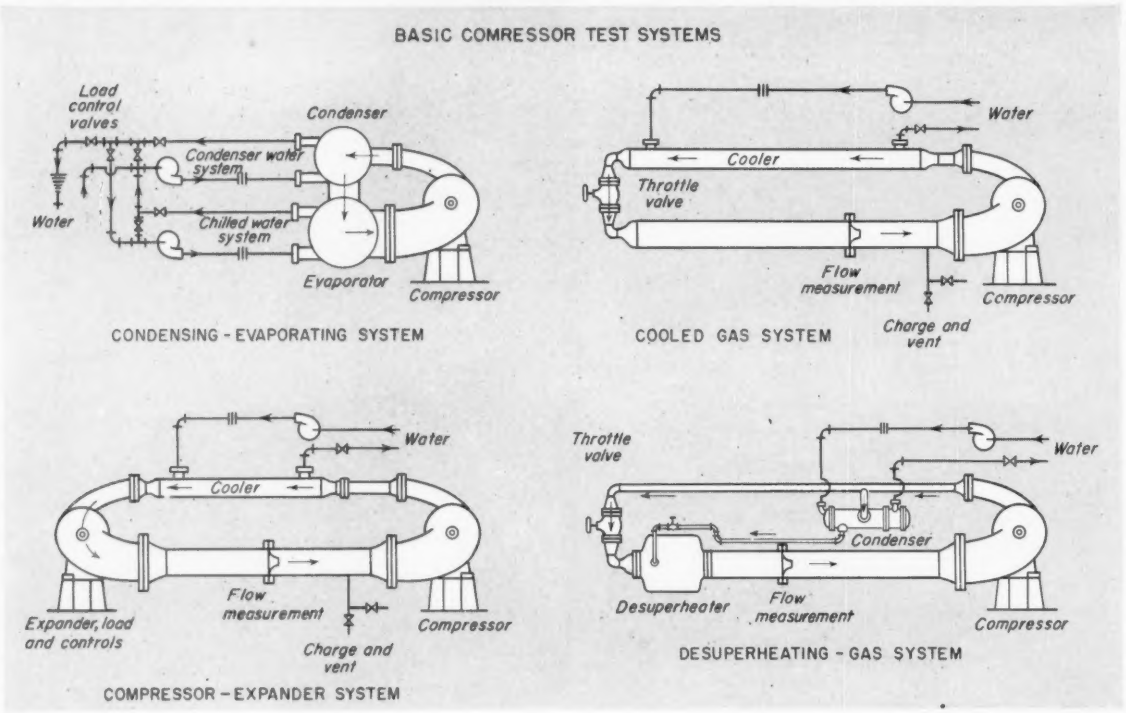
FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

FOXBORO
REG. U.S. PAT. OFF.
INSTRUMENTATION FOR INDUSTRY

TECHNICAL BRIEFS

Latest engineering developments for busy power men

23 papers for you on
COMPRESSORS
TURBINE-GENERATORS
NUCLEAR POWER
REFRIGERATION



EACH TEST SYSTEM, *above,* has advantages and shortcomings. Desuperheating gas cycle was chosen by author's company.

Compressor testing meets industry needs

An automatic, spray desuperheating, closed system for testing compressors. *By C A Macaluso, Worthington Corp.*

The need, functions, and requirements of a closed system for testing centrifugal refrigeration compressors are presented. Suitable basic cycles are discussed and the desuperheating cycle is described in detail. Economic and engineering design criteria for a desuperheating system are given. Controls, instrumentation, operation and electronic data-processing are also treated.

The author concludes that tests conducted for a period of about one year on a closed, spray-desuperheating compressor-type system with three refrigerants have shown that this type of system very satisfactorily fulfills the needs of centrifugal refrigeration-compressor testing.

The main operating problems to date have been associated with in-leakage of air. A test-fluid sampling device to detect foreign gases and improved sealing would be helpful.

Significant improvements in response, test time, operating costs, operating-range, control and accuracy over that attainable with former test systems have been realized. *ASME paper No. 56-A-153.*

Equivalent performance parameters for turboblowers and compressors. *By Hunt Davis, Worthington Corp.*

The author defines the parameters of equivalent performance for turbo-compressors and shows how they may be used for correlation of shop and field testing with design information.

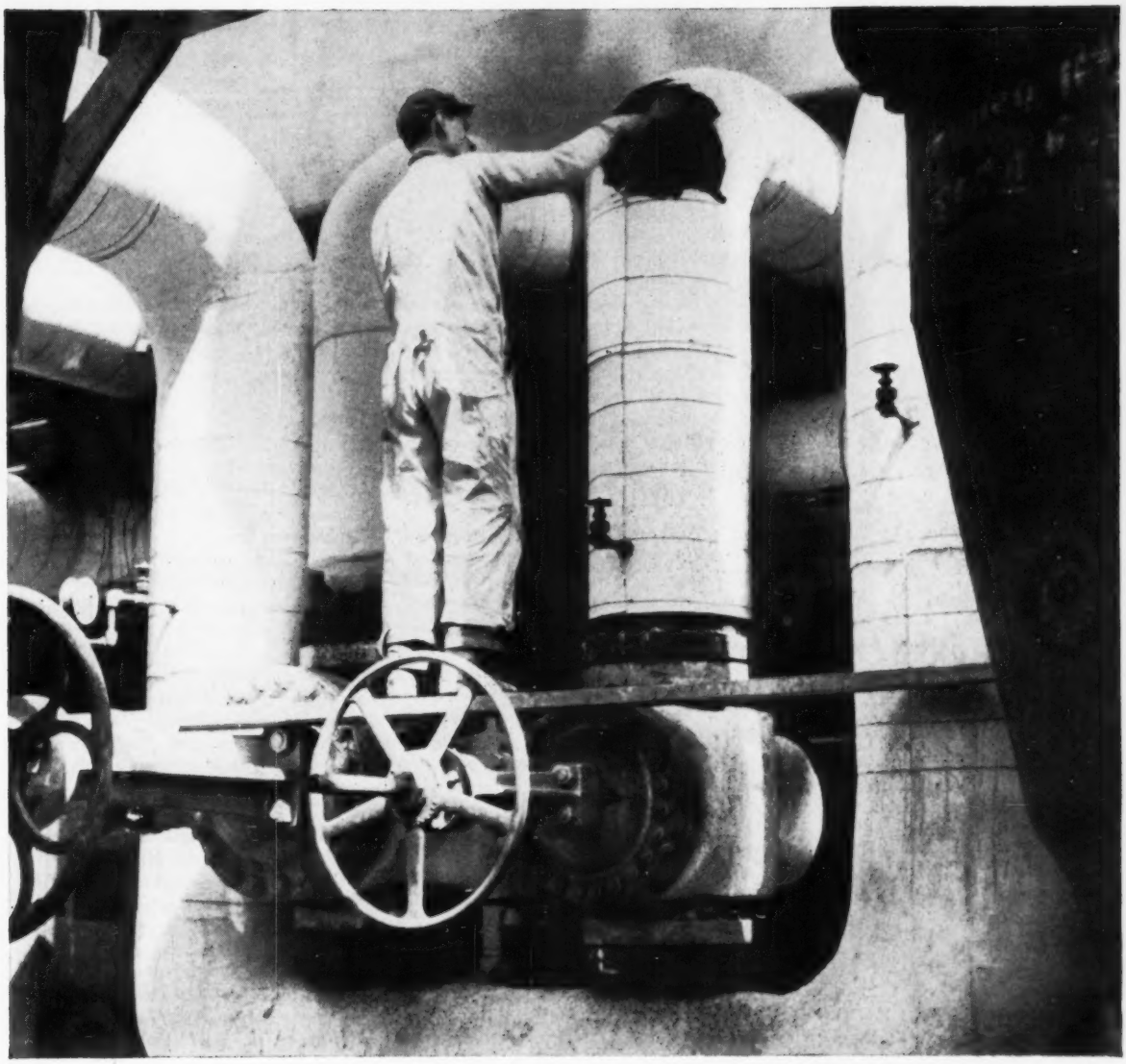
Three classifications of correlation are defined. The first class includes cases where the correlation error is negligible, even when the test fluid is different from the design fluid. The second class includes cases where correlation accuracy is reasonably good. The third offers no satisfactory correlation conditions.

The author proposes that similar concepts of correlation be recognized by and incorporated into the appropriate *Power Test Code* for turbocompressors. *ASME paper No. 56-A-122.*

Recovery ratio—a measure of the loss recovery potential of compressor stages. *By L H Smith Jr, General Electric Co.*

Certain types of axial-flow compressor

Directions for ordering papers on page 210



J-M 85% Magnesia offers excellent workability . . . from application to finished coat.

Install lasting fuel savings and lower maintenance costs

. . . with J-M 85% Magnesia insulation!

At temperatures to 600F, no insulation is so widely used, or so closely associated with economy and increased operating efficiency as 85% Magnesia. Any wonder, then, that 71% of insulation maintenance engineers responding in a recent survey made 85% Magnesia their first choice in its temperature range.

There's good reason for this overwhelming acceptance. For J-M 85% Magnesia offers many practical advantages in both installation and service. Lightweight and readily workable, 85% Magnesia assures fast, easy application. In operation, it provides the ultimate in insulating value—long life—virtually no replacement—and the very minimum of maintenance.

To assure you maximum value in insulation application, Johns-Manville offers you complete planning and job-site service . . . practical recommendations by the world's most experienced insulation engineers, backed up by expert installation by J-M Insulation Contractors.

Write today for further information on Johns-Manville 85% Magnesia Insulation. Address Johns-Manville, Box 14, New York 16, N. Y. In Canada: 565 Lakeshore Road East, Port Credit, Ontario.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville INSULATIONS FOR LASTING THERMAL EFFICIENCY

MATERIALS • ENGINEERING • APPLICATION

More TECHNICAL BRIEFS

Begins on page 156

stage designs have the ability to add extra energy to high-loss regions of the inlet flow and thereby tend to smooth out inlet-flow distortion rapidly.

A recovery ratio, believed to give a quantitative measure of this ability for radial (axisymmetric) distortions, is defined and expressed in terms of familiar stage parameters. It is found that the flow coefficient (meridional velocity/blade speed) should have a value near 0.5 or less, and that the stage loading should be light. *ASME paper No. 56-A-206.*

Aerodynamic design of vaned diffusers for centrifugal compressors. *By C R Faulders, North American Aviation, Inc.*

Flow characteristics of a conventional vaned diffuser were determined experimentally under uniform, steady inlet flow. Performance deficiencies were found to arise from the use of blade-thickness and blade-camber distributions giving non-uniform blade loading and from boundary layer flowing along the wall and collecting on the pressure side of the blade.

Test results are presented and a method of design for improved performance is postulated on the basis of the experimental data combined with analytical relationships relating boundary-layer cross-flow to diffuser geometry. *ASME paper No. 56-A-213.*

The design and operation of an electrical analog of a reciprocating compressor installation. *By J V Hughes, Continental Can Co, and J M Sharp, Southwest Research Institute.*

The basic circuitry for an electrical analog of a reciprocating-compressor installation is presented and the choice of basic analogies discussed. Equations are derived for the voltage wave form required to operate this circuit so that compressor action is duplicated. The construction of the analogs of multicylinder installations now being used to design piping to improve compressor performance and control pulsations is discussed and samples of data taken from these analogs are presented. *ASME paper No. 56-A-200.*

Turbine generators

Turbine-generator operation and maintenance practice of Philadelphia Electric Company. *By E I Gallagher, Philadelphia Electric Co.*

The system is operated on 13- and 33-kv bus voltage schedules for the various locations. Generators carry the required voltage to maintain the scheduled bus voltage and the necessary reactive.

Condensing units from 60 to 182 mw capacity are taken off nightly for as short a time as four hours. These units are returned to service in twenty minutes after a shutdown of less than eight hours.

The generator maintenance crew looks for physical damage to the generators. Collector rings are never ground or polished unless they are giving trouble. Nothing is done to them on the basis of appearance. Field winding resistance is carefully measured during complete inspection. Armature and field are meggered at 500 v every month or when possible. No routine high-voltage tests are made.

The author concludes that since internal inspections after the first year have shown relatively little trouble, the period between subsequent complete inspections is being extended to as much as five years. No generator forced outages have been attributed to operating practices. *AIEE paper No. 55-117.*

Turbine-generator rotor prewarming. *By W J Gilson, Jr, and M Temoshok, General Electric Company.*

Investigating the heat absorption characteristics of turbine-generators shows that the effectiveness of prewarming depends on the method used, the rate at which heat is applied and the temperatures of the cooling medium.

Using excitation current in the field windings appears to be the most practical and efficient method for warming because of the resulting greater penetration of heat into the rotor.

The temperature of the inner parts of the generator rotor during prewarming depends on the rate of warming as well as the type of heat source. The warming rate should not exceed 10 C per hour, using excitation current, to achieve an effective temperature distribution within the rotor.

Prewarming requires little change in operating procedure except for possibly extending the time for starting.

Although the mechanics of rotor prewarming and field coil preheating are quite different, each reduces the compressive stress in the field coils and the abrasion of the insulation. The differential temperature between field coils and rotor steel is not so great during the rotor prewarming as during the coil preheating and the resultant benefits are therefore not so great. *AIEE paper No. CP 57-217.*

Directions for ordering papers on page 210

Destructive breakdown tests on a large turbine-generator stator winding. *By A M Nemetz, Consumer Power Co, M S Kirwin, Commonwealth Associates, Inc, and J S Johnson, Westinghouse Electric Corp.*

The principal objectives in the test program were (1) To obtain more information about the relative effectiveness of dc leakage-voltage tests in searching out insulation weakness. (2) To obtain more information on the effects of varying amounts of superficial and acute tape separation on the ac and dc strength of stator coil insulation.

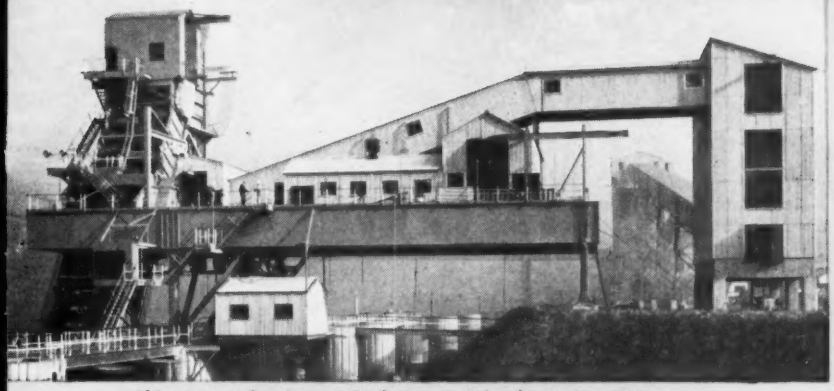
The test program was divided into two principal parts. A series of dc tests was made on the individual phases of the machine before disassembly. After completing these tests, the generator was dismantled and stator winding end connections opened. This isolated each coil half. Dc and ac breakdown tests were made on the individual coil halves.

Conclusions include the following: (1) It is possible to equalize the effect of absorption current in the leakage vs applied voltage data by properly selecting the test duration at each voltage step. (2) It does not appear possible to predict the breakdown voltage for certain types of insulation defects prior to failure by the use of leakage vs voltage curve. (3) There appears to be a definite advantage in testing each phase separately when making dc nondestructive tests. (4) Satisfactory and reliable coil repairs can be made in the field. *AIEE paper No. 57-126.*

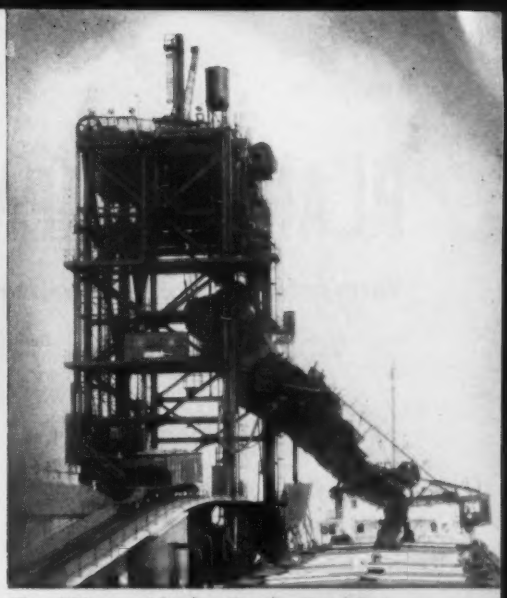
Eddy currents in the end portion of turbine-generator stator windings. *By C W Staats, Allis-Chalmers Mfg Co.*

The problem of calculating eddy current loss in the end portion of turbine-generator stator windings involves a study of the complex three-dimensional field of the end region of the machine.

This paper subdivides the field into components and then offers solutions for each component by two-dimensional methods. The components are combined to give the total flux density at any point. Once the flux density is known, eddy current loss is calculated by methods previously developed for bus bars and laminated cores. Experimental verification is presented. *AIEE paper, No. 57-127.* (*Continued on page* 196)



This newest Continuous Bucket-type Unloader is operating in excess of its rated capacity of 1800 tons per hour. It is the second of its kind for the same customer.



The "Giant with the Gentle Hands" is a familiar landmark on Lake Erie and on the Atlantic Coast. As many as 60 coal cars per hour have been loaded with minimum degradation by this high-lift dumper.

COAL HANDLING

brings to mind

HEYL & PATTERSON

The Inland Waterways and Harbor Lines of the Great Lakes and the Atlantic Coast are dotted with H & P loaders and unloaders busily handling coal in and out of barges and ships. Since 1904—Heyl & Patterson equipment has been setting standards of performance for such service. H & P's wide variety of designs permit our engineers to recommend just the right type and the right size of equipment, so that the coal can be moved swiftly and economically. Every precaution is taken and equipment is provided to avoid undesirable degradation.

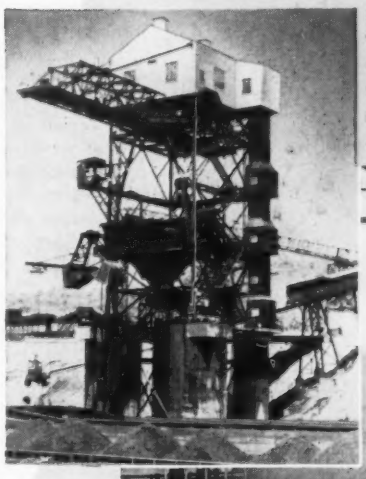
The photographs show a few of the many types of equipment we have built. Each unit was designed for specific conditions and requirements—yet they all possess the common quality of built-in efficiency and economy of operation. You will find H & P coal handling equipment at work in coal preparation plants, power stations, and at major coal transfer points.

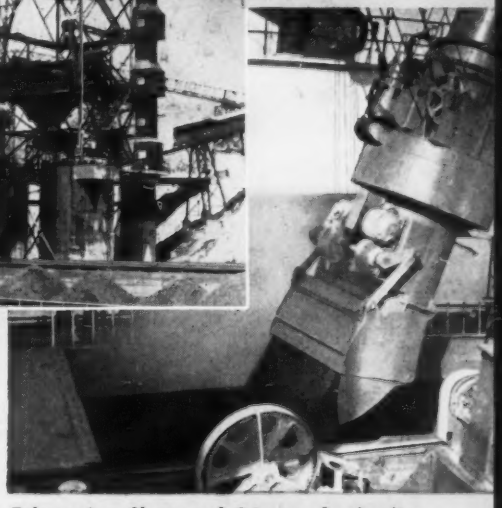
With correct functioning of the equipment in mind, H & P engineers have undivided responsibility all the way from design to erection. Called into consultation by the customer during the planning stage, they retain direct supervision until the equipment is installed and in satisfactory operation.

Let a Heyl & Patterson sales engineer tell you how we handle the complete job—all the way from design to erection—the H & P "turn-key" way.

When Experience Counts . . . Count on Heyl & Patterson!

Stationary and Traveling Unloaders serve barges and ships with sustained high capacities. This is a widely used design embodying many technical refinements for economical operation.





Telescoping Chute and Trimmer for loading coal with minimum degradation. Equipment is capable of loading 3500 tons of coal per hour, and users claim 30% reduction in overall loading time.

Heyl & Patterson INC.

70 YEARS OF SERVICE

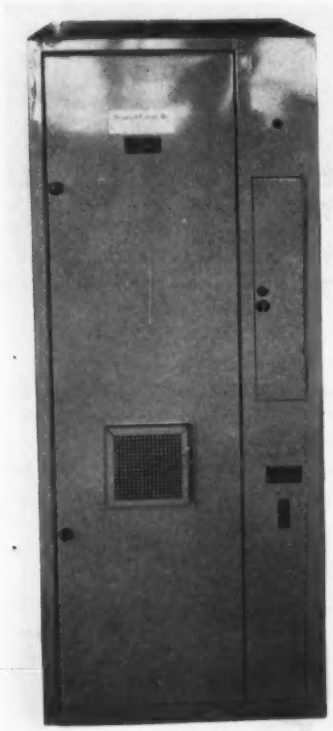
55 FORT PITT BLVD. • PITTSBURGH 22, PA.

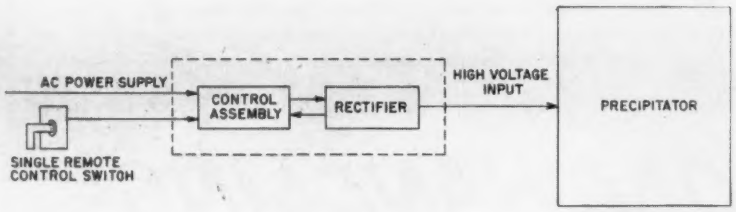
BARGE AND CAR HAULS
BRADFORD COAL BREAKERS
CAR DUMPERS
COAL BRIDGES
COAL PREPARATION PLANTS
SPECIALIZED CONVEYING SYSTEMS

PLANT EQUIPMENT NEWS

Your information center for new products designed to solve plant problems

Published monthly as a service to readers





Electronic system brings automation to precipitators

401 • Electronic system brings complete automation to power supplies of electrostatic gas cleaning systems.

Automatic feedback control is said to eliminate the snarls, snags and expense of high voltage inputs to precipitator installations. Manual and visual controls are replaced by continuously acting feedback servo-circuits.

Previously, adjustments of each electrical set in a precipitator installation were made manually by an operator at a control panel. This required, for maximum efficiency and economy, the supervision of an experienced operator controlling a multitude of knobs, meters and panels. New system eliminates this.

The accompanying block diagram indicates how the system operates. A simple switch starts and stops operation of the automation circuits in the electrical control assembly. This assembly is the heart of the system, instantaneously adjusting and maintaining high voltage output of each rectifier at a preset point of highest performance, regardless of changing process or precipitator conditions.

Continuously operating feedback loop compares actual current, voltage and sparking conditions in the precipitator with preset reference levels.

Research-Cottrell, Inc
Bound Brook, N. J.

Safety switches for light-to-heavy duty

402 • Line of safety switches meets latest NEMA standards. New industry specification clarifies the conflicting features which existed under old designations, specifies added performance and introduces a new heavy duty industrial switch. Three types of switches are included:

Type LD for light duty. Replaces the former *D* or *G* types. Line includes a full range from 30 to 200 amp in both general purpose and raintight enclosures. NEC hp ratings are included.

Type ND for normal duty and commercial work. Replaces the former *H, S, A* or *C* destinations. Full line extends from 30 through 1200 amp in both 250 and 600 volt, ac and dc, in both general purpose or raintight enclosures. Both NEC and dual element hp ratings are included. Includes an independent quick-make, quick-break operating mechanism.

Type HD for heavy-duty industry use. Enclosures include gasketed industrial type as well as water-tight, dust-tight and explosion resisting types. Request details.

Square D Co, 6060 Rivard St, Detroit 11, Mich.

Control guards against heat damage

403 • High-temperature limit control is designed for fast-acting precision control of critical temperatures. Unit acts to cut off heat supply if a predetermined temperature, set on the calibrated scale, is exceeded.

According to manufacturer, it protects against loss or damage which might result from overheating.

Bulb temperature is indicated, at all times, on the calibrated scale. Instrument provides a second check on process temperature, and indicating feature gives visual proof that control is in operating condition, ready to shut down the process should safe operating temperature be exceeded.

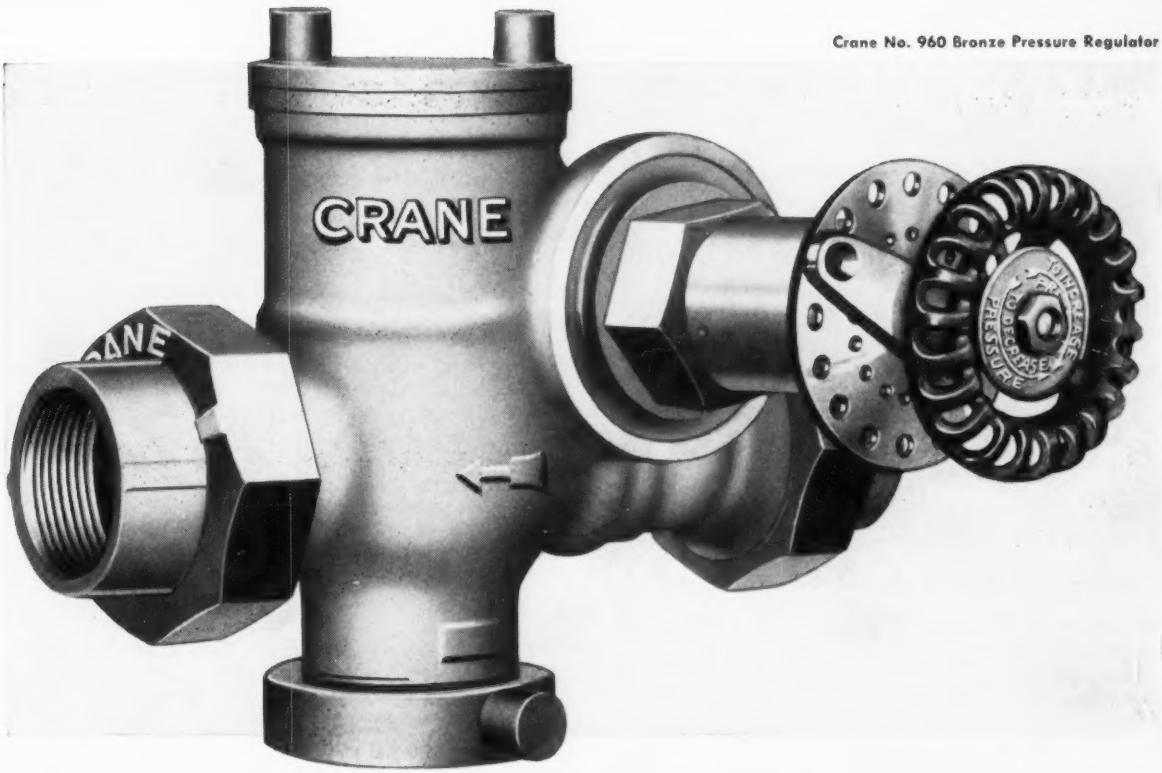
Snap-acting switch is manual reset type. Once temperature has risen to predetermined set point and switch has broken the control circuit, circuit cannot be re-established until manual reset button has been pressed.

Second switch has been provided in series with control switch. This second switch is normally closed. Will open only if temperature drops below lowest ambient temperature.

Partlow Corporation,
Campion Rd & Partlow St, New Hartford, New York

For more data on these items, use post cards on page 169. Identify your request with item number

Crane No. 960 Bronze Pressure Regulator



for dependable, *precision* control of steam and air pressure

CRANE PRESSURE REGULATORS

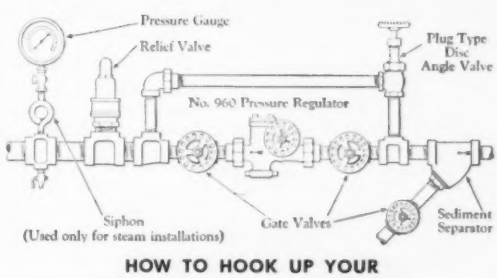
For accurate regulation of steam and air pressure, you're safe and sure when you specify Crane No. 960 Bronze Pressure Regulators.

Because they are Crane-designed and Crane-built for long, trouble-free operating life, these rugged, precision type regulators meet the most exacting requirements of modern heating systems, air blasts, cookers, driers, vulcanizers and other process equipment.

With Crane Bronze Pressure Regulators, outlet pressure cannot build up to inlet pressure when there is no steam or air demand on the outlet side. Equally important, ordinary fluctuations of inlet pressure do not affect the outlet pressure.

NEW LITERATURE ON REQUEST

Available in sizes ½ to 2 inches; maximum inlet pressures 250 pounds air or 250 pounds steam up to 450° F.



HOW TO HOOK UP YOUR CRANE PRESSURE REGULATORS

New circular helps you select proper regulator for your needs. Ask your Crane Representative for a copy, or write to address below.

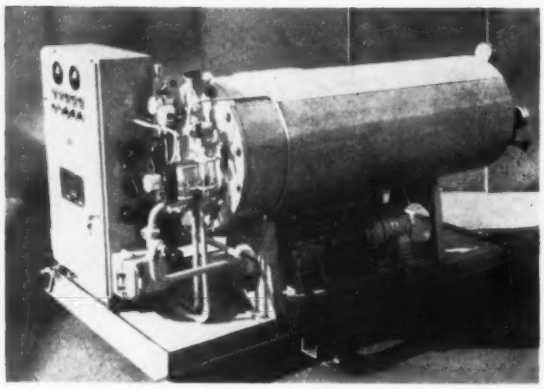
CRANE VALVES & FITTINGS

PIPE • PLUMBING • KITCHENS • HEATING • AIR CONDITIONING

Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

More EQUIPMENT NEWS

Begins on page 160



Oil conditioning plant: 53 to 70 gph

404 • Vacuum oil purification plant is available in several models for capacities ranging from 53 to 780 gph. Plant purifies insulation oil by filtering, de-aerating, drying it in continuous process. Heating of oil in the process can be electrical or by steam. Models with oil separator are also available. Unit can be stationary, mounted on casters, or on a trailer with pneumatic wheels and protective housing.

Unit is intended for purification of insulating oil for transformers and switches. It is said to be useful for small and medium size power plants, and for manufacturers of oil-filled electrical equipment. Manufactured by A Hering —Nürnberg. Sole U.S.A. distributors. . . .

Epic, Inc, 154 Nassau St, New York 38, N. Y.

Lithium-based grease—jack of all trades

405 • Multi-purpose grease, with an improved lithium base, is engineered to meet nearly all industrial lubrication requirements, according to manufacturer.

Product is designed to provide lubrication under conditions which often require a variety of special greases. Among such conditions are high and low temperatures, the action of water, high-speed bearing action, storage.

Manufacturer says that single-product multi-purpose grease reduces error in application, cuts lubrication costs, reduces number of grease guns needed, and simplifies problems of storage handling and inventory. Manufacturer claims grease has high oxidation stability, high mechanical stability, ready flow in cold, resists damp.

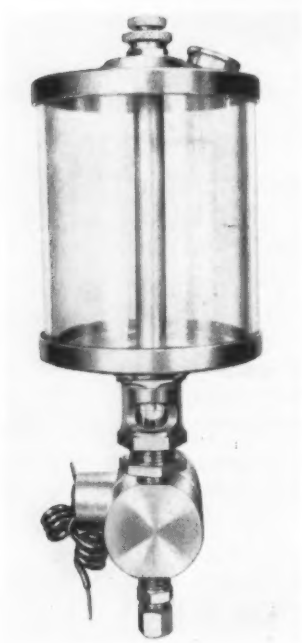
Gulf Oil Corp, 1822 Gulf Building, Pittsburgh 30, Pa.

Lube resists washing action of solvents

406 • In lubricating a pump or other equipment used in the handling of solvents, the problem is to get a grease that will not be washed away by the solvent.

This manufacturer says that his grease is made especially to overcome that problem. Grease is said to be impervious to washing action of almost all petroleum and chlorinated solvents. Among other things, it is unaffected by naphtha, kerosene, gasoline, lp-gas, and fuel oils. Consistency remains relatively unchanged in use; may be pumped in hand grease gun at low temperature.

Pennsylvania Refining Co
2686 Lisbon Rd, Cleveland, Ohio



Gravity-feed industrial oiler

407 • Oiler is said to eliminate dry starts of machinery that has been shut down overnight or on weekends.

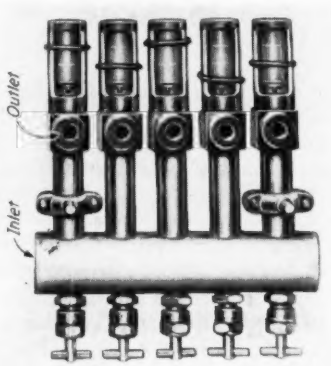
Special reservoir built in the oiler automatically floods bearing with a fixed amount (approx 1/8 oz) of lubricant when oiler valve is opened.

Following flushing cycle, oiler functions in normal manner, feeding lubricant drop by drop at any required rate, and again stores up oil for next flushing cycle while machine is idle.

According to manufacturer, oil flushing after shutdown periods is especially desirable with (1) vertical shafts, where oil drainoff is especially pronounced and (2) high speed spindles where full lubrication is required the instant the machine is started.

Oilers come in 10 oz, 1 pt, 1 and 2½ qt sizes, with manual or electrical solenoid shutoff valves.

Trico Fuse Mfg Co, 2948
N 5th St, Milwaukee 12, Wis.

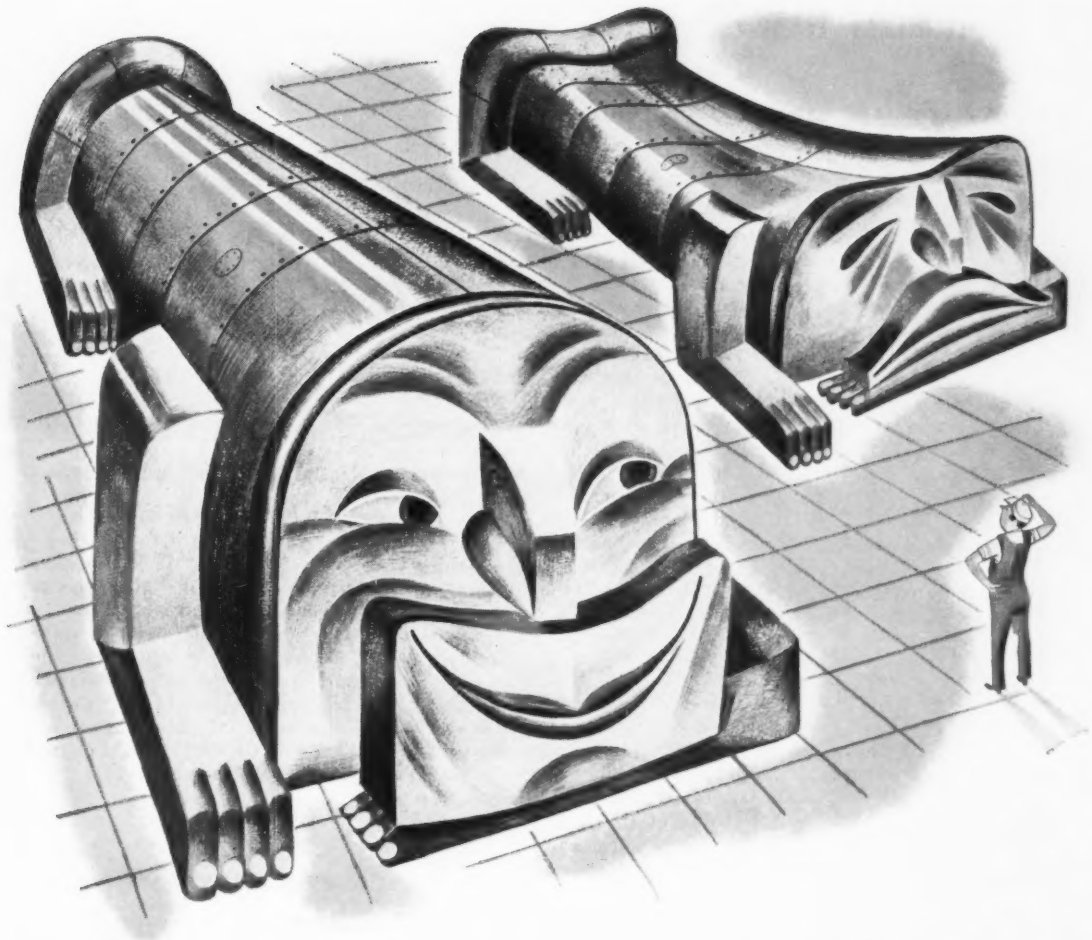


Pressure sight flow lubricator

408 • Unit will deliver lubricating oil or other liquids under pressure, in accurately measured quantities, to high or otherwise inaccessible points. Available as single units or in multiples to 15 depending upon number of feeds.

Wm W Nugent & Co, Inc, 3440
Cleveland St, Skokie, Illinois

For more data on these items, use post cards on page 169. Identify your request with item number



Will it Generate or Degenerate?

The Correct Turbine Oil can make the difference

The tremendous investment any turbine represents is a mighty powerful reason for using Cities Service Turbine Oils.

For Cities Service "Pacemaker-T" Turbine Oils provide unsurpassed anti-foam and anti-rust protection, plus maximum oxidation stability and water separation . . . factors that keep your equipment generating without degenerating.

Moreover, there's a Cities Service Turbine Oil with the precise viscosity and makeup for every type of turbine, every type of oiling system and every type of operating condition.

Get the details from the Cities Service Lubrication Engineer at the nearest Cities Service office. Or write: Cities Service Oil Company, Sixty Wall Tower, New York 5, N. Y.

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

More EQUIPMENT NEWS

Begins on page 160

Lightweight taper face flange protects valves

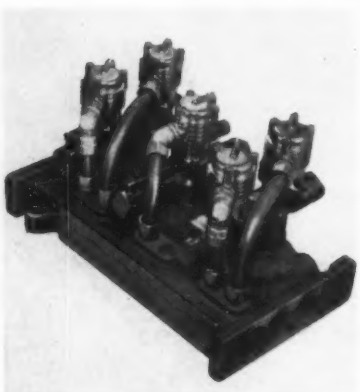
409 • Unit is said to offer important technical and cost advantages where lighter schedule of pipe must be connected to 125 lb cast iron valves and other equipment.

According to manufacturer, tapered face causes greater pressure to be exerted near the bore. This is said to eliminate problems of obtaining a leakproof seal when a conventional flange is used with a full-face gasket. It is also said that the unit can be bolted to cast-iron or semi-steel flanges without overstressing them or the integrally cast valves and pumps they serve.

Unit is rated at 125 lb for water, oil and gas service. Request details.

Tube Turns, 224 E Broadway
Louisville 1, Kentucky

Manifold designed for multiple valve mounting



410 • This manifold is designed for multiple mounting of 2, 3 or 4-way valves in any desired combination.

Available in 2 and 3-station types, aluminum unit has full length inlet and exhaust ports, both 1 in. NPT, common to all valve stations.

According to manufacturer, unit adapts to any control valve application. Combinations of single or double solenoid valves can be mounted at any station on the manifold. Valves can be used in any combination. Manifolds made with side or bottom cylinder porting.

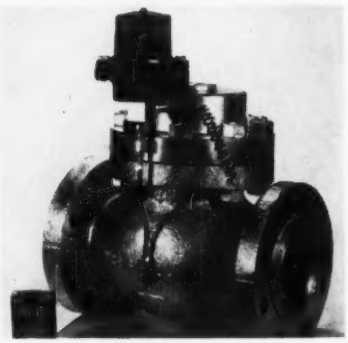
Valvair Corporation
454 Morgan Ave, Akron 11, Ohio

Plastic in pipe fitting promises end to leaky joints

411 • Paper-thin layer of plastic on a section of inside wall of pipe fitting promises, according to manufacturer, to do away with leaks at joints in cemented, or solvent-welded, plastic pipe installations.

High contact pressure between pipe and fitting is said to cause a positive weld strong enough, in seconds, for ordinary handling. In two hours, solvent-softened plastic in weld area has completely hardened.

U. S. Rubber, 1230 6th Ave
New York, N. Y.



Cast steel solenoid valves

412 • Line of valves for liquids to 600 psi are available in sizes 2, 2½, 3 and 4 in. Can be either globe or angle pattern with screwed or flanged pipe ends.

Features include renewable seat rings, unbreakable piston rings and packless operation over a wide pressure range. Valves are designed to eliminate damaging hammer and shock in automatic or remote control.

J D Gould Co, 4707 Massachusetts Ave
Indianapolis 18, Ind.

Corrosion service needle valve

413 • Bubble-tight needle-valve is said to be compatible with standard fittings and piping methods of any material. Units are designed to meet requirements of modern fluid systems where corrosion problems exist from internal, external, chemical, electrical or even natural corrosive elements. All contact with liquids is restricted to corrosion resistant plastic material.

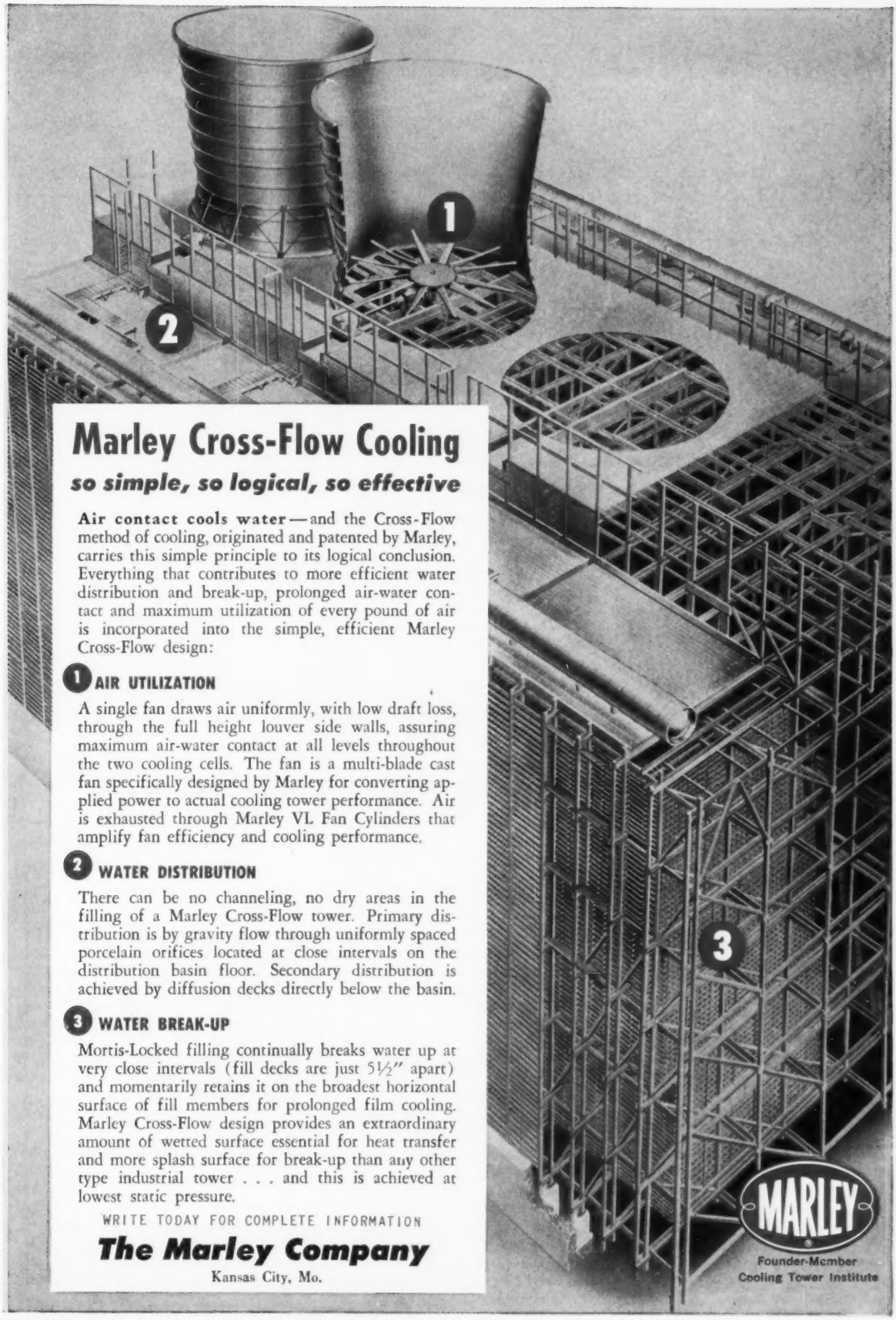
Chemtrol Corp, 1513 W
El Segundo Blvd, Compton, Calif.

Single valve steam trap

414 • Steam trap uses one valve to vent air and discharge water. In addition it acts as a check valve. In cold state the valve is kept open by line pressure or gravity allowing high capacity air venting. When steam enters trap body, valve is closed tight by steam temperature acting on bimetallic element. Unit is free-floating.

Velan Valve Corporation
37 S River St, Plattsburg, N. Y.

For more data on these items, use post cards on page 169. Identify your request with item number.



Marley Cross-Flow Cooling

so simple, so logical, so effective

Air contact cools water—and the Cross-Flow method of cooling, originated and patented by Marley, carries this simple principle to its logical conclusion. Everything that contributes to more efficient water distribution and break-up, prolonged air-water contact and maximum utilization of every pound of air is incorporated into the simple, efficient Marley Cross-Flow design:

1 AIR UTILIZATION

A single fan draws air uniformly, with low draft loss, through the full height louver side walls, assuring maximum air-water contact at all levels throughout the two cooling cells. The fan is a multi-blade cast fan specifically designed by Marley for converting applied power to actual cooling tower performance. Air is exhausted through Marley VL Fan Cylinders that amplify fan efficiency and cooling performance.

2 WATER DISTRIBUTION

There can be no channeling, no dry areas in the filling of a Marley Cross-Flow tower. Primary distribution is by gravity flow through uniformly spaced porcelain orifices located at close intervals on the distribution basin floor. Secondary distribution is achieved by diffusion decks directly below the basin.

3 WATER BREAK-UP

Mortis-Locked filling continually breaks water up at very close intervals (fill decks are just 5½" apart) and momentarily retains it on the broadest horizontal surface of fill members for prolonged film cooling. Marley Cross-Flow design provides an extraordinary amount of wetted surface essential for heat transfer and more splash surface for break-up than any other type industrial tower . . . and this is achieved at lowest static pressure.

WRITE TODAY FOR COMPLETE INFORMATION

The Marley Company

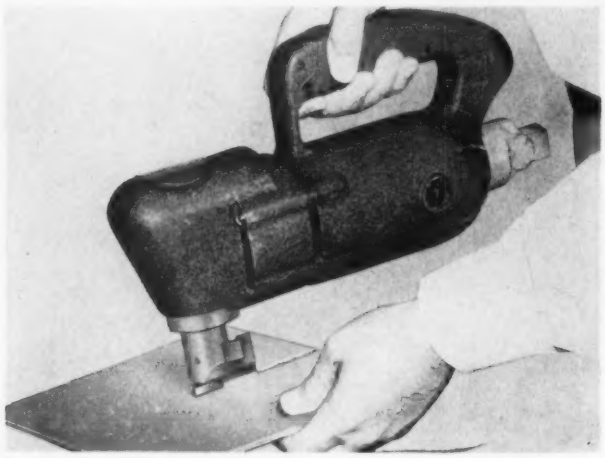
Kansas City, Mo.

MARLEY

Founder-Member
Cooling Tower Institute

More EQUIPMENT NEWS

Begins on page 160



Nibbler cuts ferrous, non-ferrous metals

415 • Lightweight 12-lb nibbler cuts up to 3/16″ of copper, brass, aluminum, 10 gage stainless, 8 gage mild steel. Nibblers operate on punch and die principle, enabling user to cut ferrous and non-ferrous metals without distortion, thus reducing scrap waste.

Tool is both electric and air operated. It will follow a line or template with little effort and, according to manufacturer, will cut a radius as small as three in. Manufacturer also claims that it can cut inside circles, squares and odd shapes.

Unit comes in four models. The universal electric motor develops 1 hp. All models operate on ac or dc, 115 volts, 60 cycles, with 220 volt optional at additional cost.

Unit operates at a speed of 60 in. per minute. It is said to have slashed maintenance jobs by as much as 75%. Care is said to be simple. Light grinding will keep punch and die sharp.

Pensco Products, 527 Lexington Ave, New York 17, N. Y.

Multi-use spray cleans motors

416 • Grease, oil, carbon, tar gums and similar difficult-to-remove substances can, according to manufacturer, be removed quickly, easily and safely by aerosol degreaser. This spray is designed for use on all types of machinery and electrical equipment.

According to manufacturer, spray is excellent for cleaning motors and other electrical, oily and mobile equipment. It will also, it is said, remove greasy stains from painted surfaces and concrete floors.

Product dries rapidly, leaving no film or vapor. Manufacturer claims that it will not short electrical equipment, and that it is non-corrosive, non-flammable and safe for painted surfaces. Does not contain carbon tetrachloride. Packing is 16 oz net weight per can.

Stewart-Hall Chemical Corp
Box 66, Mount Vernon, N. Y.

Wetting agent feature of degreaser

417 • Heavy-duty degreaser, *MM-17*, contains wetting agent which lowers surface tension of cleaning solvents. Manufacturer claims that it is this surface tension which retards movement of other solvents into areas where they are most needed. It is said that wetting agent in *MM-17* drives solvents through and under foreign deposits, breaking the bond between soil and the surface to which it adheres. Water emulsifies oil and solvents. Request additional details.

The Daniel Co, 17 Bolt St, Lowell, Mass.

For more data on these items, use post cards on page 169. Identify your request with item number

Grinder removes metal and buffs castings

418 • Portable air-motor grinders and attachments are suitable for grinding, buffing and polishing operations. The model 700 horizontal grinder is designed for metal removal or buffing of castings, forgings and welds.

For grinding or sanding on flat surfaces or on curved surfaces when a flexible disk is used, manufacturer has designed the Model 700-A right angle grinder. It has the advantage of a large grinding surface which will cover more work area in short time.

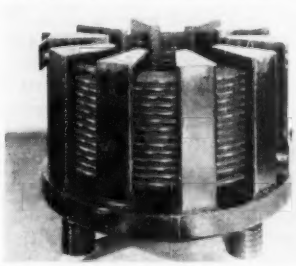
Airetool Mfg Co, 302 S Center St, Springfield, Ohio

Concrete mix sprays on to desired thickness

419 • Concrete mix can be applied swiftly by spraygun and pressure pot to any desired thickness. Manufacturer claims that all the advantages of concrete over organic coatings, such as heat resistance, poor electrolytic conductivity, extreme hardness and relatively high resistance to salt water, frost and most alkalis and acids are retained. Only a 65 cfm compressor is needed. Request additional details from manufacturer.

Chemical Fire and Rustproofing Corp
50 Cutter Mill Rd, Great Neck, N. Y.

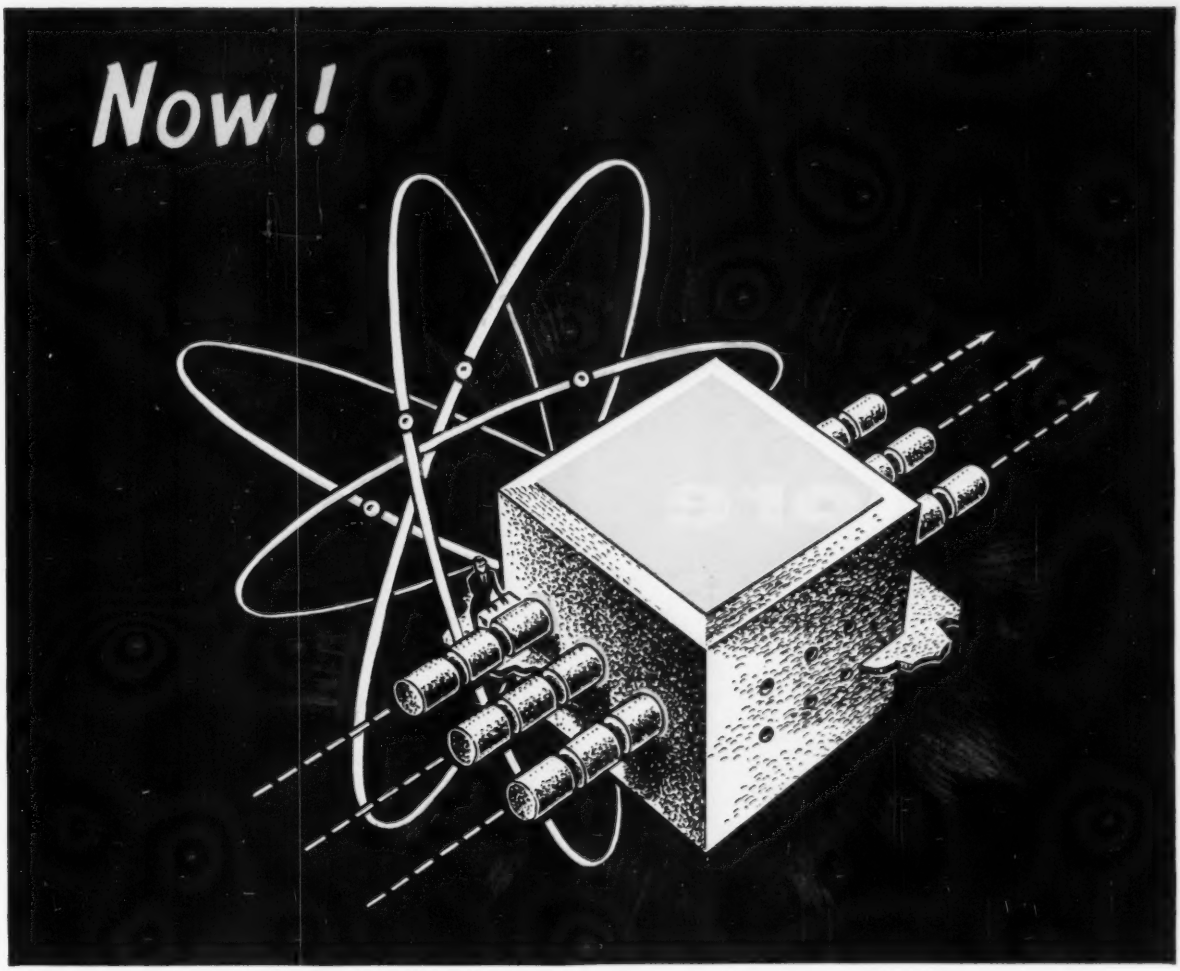
Be sure to check this item . . .



Current-limiting reactor . . . . . p 212

. . . and these and the many other appearing on pages noted below:

Portable generator . . . . . p 214
Controlled volume pump . . . . . p 216
Aluminum welding fittings . . . . p 218
Differential pressure switch . . . p 220
Cage protector . . . . . p 222



Norton ceramic fuel elements

Separate facility now producing ceramic fuel elements and various reactor components

To meet the demand for more-economical, more-efficient reactor fuels, the trend is towards ceramic types — because of their greater resistance to corrosion and radiation, the ease with which they can be reprocessed, and their ability to operate at higher temperatures. Norton Company's long experience in the development of high-purity ceramics has now led to the commercial production of ceramic fuel elements.

Take Advantage of Norton Assistance in bringing special nuclear materials into successful use in the development of nuclear power plants. In addition to the development and production of ceramic reactor components, Norton experience includes highly specialized refractories for missile, metallurgy, chemical, and furnace applications. These top-performing Norton refractory ℞'s — *engineered and prescribed* for the widest range of uses — are of increasing interest to nuclear engineers. They include alumina, silicon carbide, thoria, urania, zirconia, magnesia, dolomite, and numerous borides, carbides and nitrides — that have benefited nuclear as well as general industrial developments.

A special Norton Research and Development section, devoted to the development of precision ceramics and familiar with both nuclear and refractories development, co-operates whenever possible with industrial, government and academic research activities. Your progress may be speeded up by utilizing Norton co-operation and products. For further information write to NORTON COMPANY, Refractories Division, 443 New Bond Street, Worcester 6, Massachusetts.

NORTON
REFRACTORIES
Engineered... ℞ ...Prescribed

Making better products... to make your products better

NORTON PRODUCTS: Abrasives • Grinding Wheels
Grinding Machines • Refractories
BEHR-MANNING PRODUCTS: Coated Abrasives
Sharpening Stones • Behr-cat Tapes

...more quality proved POWELL VALVES

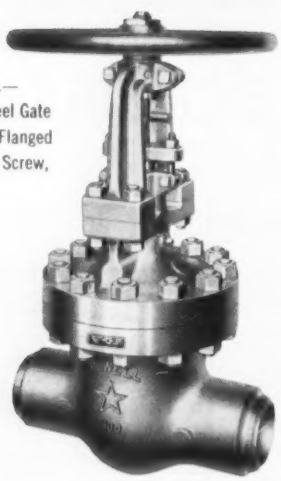


FIG. 9003 W.E.—
900-Pound Steel Gate
Valve, Bolted Flanged
Yoke, Outside Screw,
Rising Stem.

FIG. 375—Bronze Gate Valve
for 200 Pounds W.S.P. Inside
Screw Rising Stem.

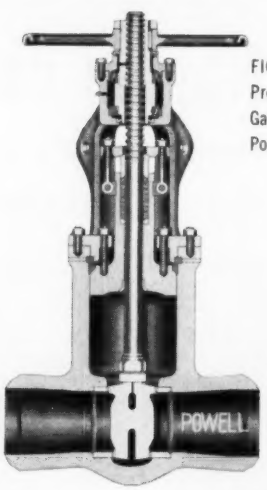


FIG. 11303 (Sec.)—
Pressure Seal Steel
Gate Valve, 1500
Pounds. Welded Ends.

Designed for long life, designed for dependable service

Consult your Powell Valve distributor for all the facts about quality proved bronze, iron, steel and corrosion-resistant valves. For every flow problem . . . there is a Powell Valve to solve it.

THE WM. POWELL COMPANY, CINCINNATI 22, OHIO . . . 111th YEAR

Keep yourself up to date . . .

To get more info on new equipment or FREE copies of latest bulletins

follow these easy steps

Preceding pages tell you what's new in plant equipment. Each item is numbered. For more details on any item, write its number here.

New free bulletins are listed and numbered, beginning on back of this page. To order those you want, write POWER item number here — do not use manufacturer's bulletin number.

Put 2¢ stamp on self-addressed card and mail it to us. We'll pass along your request to the various companies, they'll send the info

I want details on these New Products:

☐ ☐ ☐ ☐ ☐ ☐

Send me these FREE Bulletins:

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Please use before August 1, 1957. Void after this date. 4/57

My Name .....
Please print

Home Address .....

City & State .....

Title .....

Company .....

Power a McGraw-Hill Publication

I want details on these New Products:

☐ ☐ ☐ ☐ ☐ ☐

Send me these FREE Bulletins:

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Please use before August 1, 1957. Void after this date. 4/57

My Name .....
Please print

Home Address .....

City & State .....

Title .....

Company .....

Power a McGraw-Hill Publication

I want details on these New Products:

☐ ☐ ☐ ☐ ☐ ☐

Send me these FREE Bulletins:

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Please use before August 1, 1957. Void after this date. 4/57

My Name .....
Please print

Home Address .....

City & State .....

Title .....

Company .....

Power a McGraw-Hill Publication

This Month's FREE Literature

PLACE 2¢ STAMP HERE

Power
Reader Service Department
330 West 42nd Street
New York 36, N. Y.

PLACE 2¢ STAMP HERE

Power
Reader Service Department
330 West 42nd Street
New York 36, N. Y.

PLACE 2¢ STAMP HERE

Power
Reader Service Department
330 West 42nd Street
New York 36, N. Y.

REFRIGERATING, VENTILATING

1 **Evaporative condensers** for ammonia and freon refrigerating systems are discussed in 12-p bulletin 234-G. Contains photos, diagrams, charts, plus info on operating principle, coil design, pumps and fans, capacities, etc. Frick Co, Waynesboro, Pa.

2 **"Comparative performance** of cooling-tower packing arrangement" is title of 8-p reprint. J F Pritchard & Co of California, 4625 Roanoke Pkwy, Kansas City 12, Mo.

3 **Power roof ventilators** are the subject of 8-p bulletin 3904. Describes construction, operation and design features of four units. Critical dimensions are given in tabular form. American Blower Corp, Detroit 32, Mich.

4 **Centrifugal air washer.** Illustrated 4-p bulletin W-7456 contains operation, installation and application info on *Type UW-4* air washer. Ducon Company, 147 E 2nd St, Mineola, N. Y.

BOILERS AND AUXILIARIES

5 **Package boilers,** in sizes from 20 to 500 hp, are described in 4-p bulletin 571-EC. Units are available with either forced-draft or induced-draft fans. Dutton Boilers Division, Hapman-Dutton Co, Kalamazoo, Mich.

6 **Desuperheater.** Illustrated 4-p bulletin M55-1 describes design, installation and typical application of high-capacity fast-acting spray-type steam desuperheater. Dimensions are provided. Bailey Meter Company, 1050 Ivanhoe Rd, Cleveland 10, Ohio.

7 **Fireclay and high-alumina brick** are described in 8-p bulletin 551. Includes photos, seven technical data tables, application info. J H France Refractories Co, 1944 France Rd, Snow Shoe, Pa.

8 **Feedwater heaters.** Illustrated 12-p bulletin 117-A describes open coil tray-type units, both deaerating and nondeaerating types, with a capacity range of 3000 to 300,000 lb/hr. Stickle Steam Specialties Co, 2215 Valley Ave, Indianapolis 18, Ind.

9 **Refractory castable,** *Kaocrete,* for use in boiler ashpits, is described in 4-p bulletin R-40. Discusses methods of ash removal and maintenance problems involved. The Babcock & Wilcox Company, Refractories Div, 161 E 42nd St, New York 17, N. Y.

AIR COMPRESSORS

10 **Air compressors** in the ¼ to 20 hp range are described as to construction details, specs and models in data sheet 653R. Brunner Mfg Co, 11 Fisher St, Utica, N. Y. (*Continued on p 244*)

Wide Size Range . . . in Any Quantity . . .
Builds UTILITY Demand for
B&W HOLLOW FORGINGS

Leading Electric Utilities—like American Gas and Electric, Carolina Power & Light, Commonwealth Edison, and Wisconsin Electric Power—use B&W hollow forgings for main steam, reheater, feedwater, and similar lines. B&W hollow forgings give them a sound solution to their piping problems.

These heavy-duty forgings can be specified to exact design requirements. They are made from high quality carbon, alloy, and stainless steels. They are produced with vigilant care under controlled conditions from the initial melt through final inspection. That's why B&W hollow forgings give users savings in time and money.

Because of B&W's specialized manufacturing process, hollow forgings can be made in special shapes or with special end preparations, such as end closures, reduced sections, and Van Stone flanges.

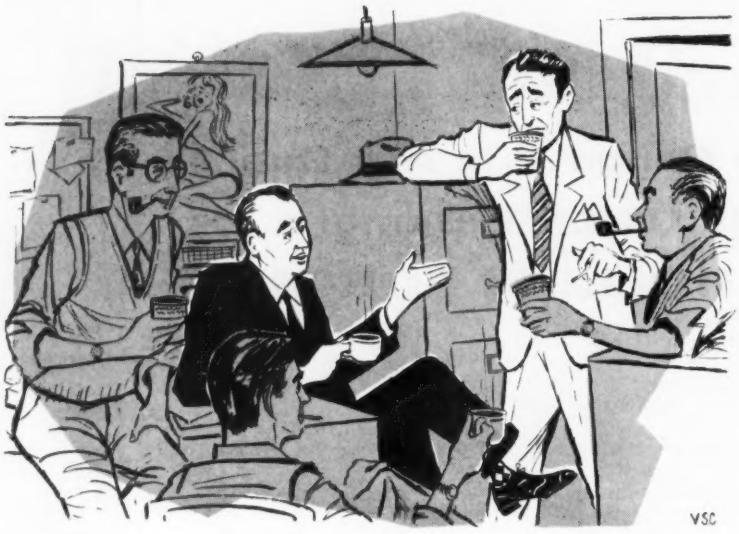
For additional information, write for Bulletin S-16B. The Babcock & Wilcox Company, Process Equipment Department, P-4, Barberton, Ohio.

Ask for this Bulletin: S-16B

BABCOCK & WILCOX

BOILER DIVISION

S-466-HF



George Edwards

recalls Thoreau's *Life Without Principle*

"Men will lie on their backs talking about the fall of man, and never make an effort to get up."

► A GROUP OF US, including a packing salesman named Miller, were taking a coffee break one morning last week when Walter Sneed walked into the shop office.

Walter worked for us until about six months ago, was with us for about two years. A good operating engineer, but I never met another man who tried so hard to make a federal project out of another fellow's mistakes. Even if a man was doing a bang-up job, Walter always knew how it could be done better. Never had a good word for anybody. Always carping, always criticizing. Finally, though we hated to lose his ability, we had to let him go.

He came in today mainly to impress us, I think. He'd left a job in Boston because "the chief didn't know enough to come in out of the rain," and was on his way to "a good job in St. Louis."

When he came in, we'd been trying to soothe Art Whelan's feelings, ruffled over a mild boner he'd pulled in the shop that morning. As George Dodds, our plant electrician put it, "You'd think Art was the only person who'd ever made a mistake."

George then told us how, years ago, he'd almost killed himself and two other guys because he'd forgotten to check a circuit-breaker. His story led to a sort of review of prize bloopers we'd all pulled at times because we hadn't used our heads.

All of us except Walter. This confession stuff was a little out of his line, so he just leaned against the wall and never said a word.

We didn't know that the packing salesman knew Walter and we were surprised when he piped up:

"Say, Sneed, tell the boys about the job you did on the brine piping in that big Philly bakery."

Walter opened his mouth to say something, but Miller had the ball and was running.

"Sneed was gonna defrost the system one night," he laughed. "Brine cooler and piping were insulated with a special beeswax and cork compound —at least they were until Walter turned steam on the brine heater section and forgot it. What a mess that place was after the pump circulated that red-hot brine for a while."

Miller looked at Walter. "I never did hear how you let that brine heater get away from you," he said. "What were you doing—showing the bakers how to make a good loaf of bread?"

The office door slammed shut after Sneed. The packing salesman looked around at us and grinned.

"I enjoy breaking it off in a guy like that," he said. "I've known him from way back and to him other people are just a bunch of dumb clucks."

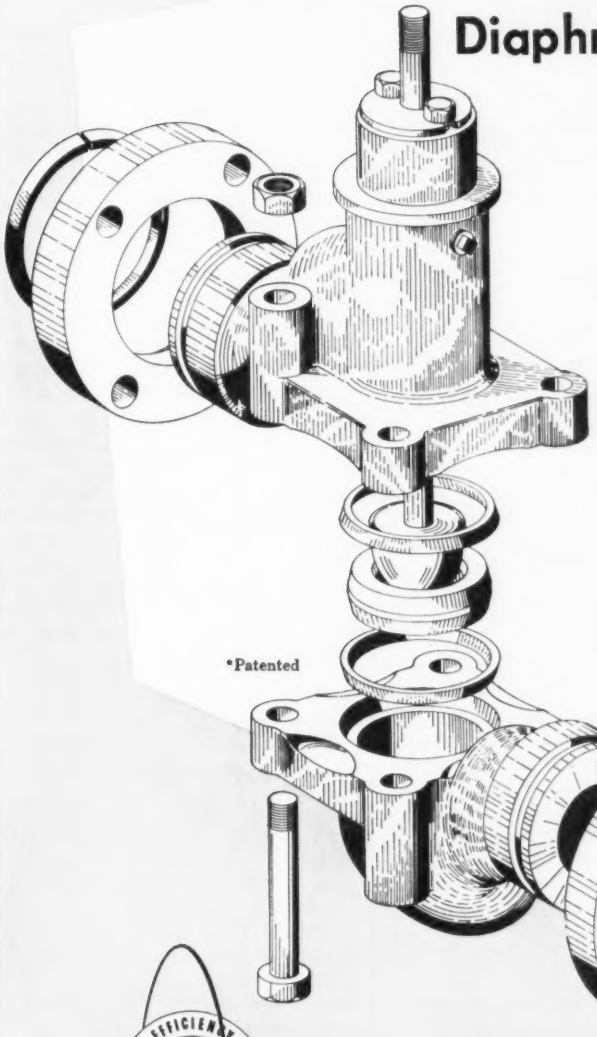
"Funny thing, too," Miller added, "Sneed really has a lot of savvy. He'd make somebody a good man if he'd just learn that little piece: 'Let him who is without fault cast the first stone.'"

For Complex Fluid Control Problems . . .

Specify The New SPLIT BODY

Super 70 *series*

Diaphragm Control Valves!



*Patented

FEATURES

✓ Body halves are joined with four bolts at junction of valve body and inner valve seat for easy access. May be assembled to provide either globe or side angle flow.

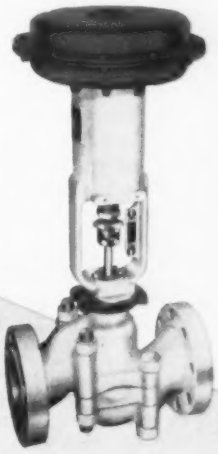
✓ Seats are available in metal, Nylon, Teflon or Kel-F.

✓ Tight closures without resort to gaskets are insured by BS&B Float Ring Seals.*

✓ Actuator may be quickly oriented to any convenient position by means of clamp ring mounting.

✓ Fewer parts mean simplified maintenance when handling erosive, corrosive or viscous liquids.

✓ Standard body materials are cast steel or 316 stainless in 1″ to 3″ sizes with a selection of inner valve types. 600 lb. ASA body with interchangeable line flanges—150, 300 and 600 lb. raised face. Other body materials available on special order.



EFFICIENCY OVER 60 YEARS BS&B RELIABILITY
ANOTHER EXAMPLE OF PRODUCT LEADERSHIP

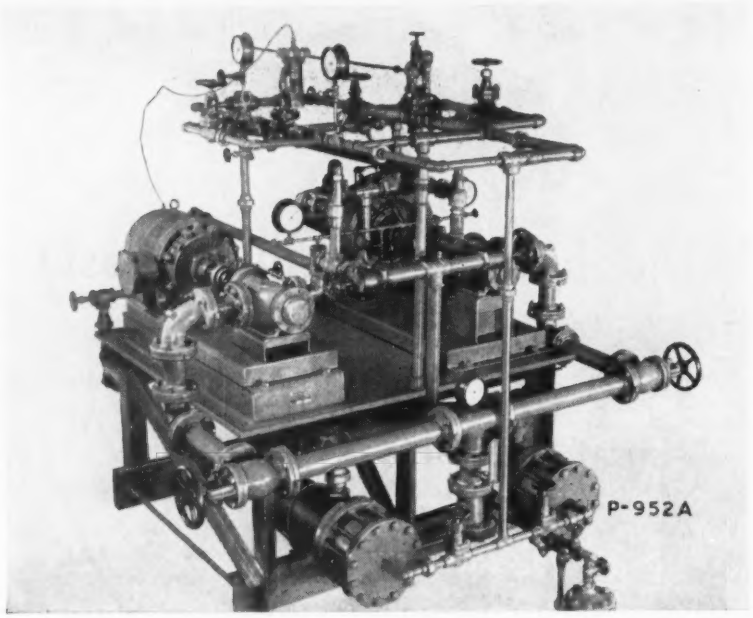
For Complete Information, Ask Your BS&B Sales Engineer—or Write for Catalog 70-11.

BLACK, SIVALLS & BRYSON, INC.

Controls Division, Dept. 4-Q4
7500 East 12th Street Kansas City 26, Missouri

COMPLETE RANGE OF SIZES AND MODELS IN BOTH MEDIUM AND HIGH PRESSURE TYPES

MORE COMPACT THAN EVER..



P-952A Steam Turbine and Electric Motor drive gives flexibility in this compact Model P-ES2H size No. 25 unit.

NATIONAL AIROIL

FUEL OIL PUMPING AND HEATING UNITS

NATIONAL AIROIL Fuel Oil Pumping and Heating Units are specially designed to prepare, for combustion, all grades of fuel oil including No. 6 or Bunker "C" Oil and residuums. They will draw fuel oil from above ground or underground tanks, preheat it to proper constant temperature and deliver it to Oil Burners at an even pressure, best suited for the burners. Our Fuel Oil Pumping and Heating Units are the result of years of experience. They come completely equipped ready for steam, exhaust, condensate, oil suction, oil return, and electrical connections. All valves, regulators, etc., are readily accessible. The piping arrangement is easily understood. These compact, space-saving units are available in a range of sizes and models in both Medium and High Pressure types. For complete details, write for our Bulletin 40 — very interesting and informative.

OIL BURNERS and GAS BURNERS for industrial power, process and heating purposes
STEAM ATOMIZING OIL BURNERS
SLUDGE BURNERS, Steam Atomizing
MOTOR-DRIVEN ROTARY OIL BURNERS
MECHANICAL PRESSURE ATOMIZING OIL BURNERS
DUAL STAGE, Combining Steam and Mechanical Atomization
LOW AIR PRESSURE OIL BURNERS
AUTOMATIC OIL BURNERS, for small process furnaces and heating plants
GAS BURNERS
COMBINATION GAS and OIL BURNERS
FUEL OIL PUMPING and HEATING UNITS
FURNACE RELIEF DOORS
AIR INTAKE DOORS
OBSERVATION PORTS
SPECIAL REFRACTORY SHAPES

NATIONAL AIROIL BURNER CO., INC.

1250 EAST SEDGLEY AVE., PHILADELPHIA 34, PA.

Southwestern Division: 2512 South Boulevard, Houston 6, Texas

TURBINE BOLTS

Continued from page 113

slightly fanning pattern from the crystal. Theoretically, if the waves traveled in a straight line, it wouldn't be possible to sonically inspect the portion of the bolt under the chamfer. But in actual practice, waves fan out and strike the bolt's outside surface about three inches from the test surface.)

2. Rough-machined or dirty test surfaces will interfere with wave transmission throughout the crystal's face. A sharp projection, breaking through the fluid couplant, causes unreliable test conditions.

A solid couplant may show "ghost" indications which aren't there when the same area is checked with a fluid couplant. This is because a solid can't give the complete and intimate contact provided by a fluid couplant between crystal face and test surface.

3. Diameter-to-length ratio doesn't affect test reliability. Bolts are designed for the end use in high-temperature high-stress applications. Any bolt designed within the established safe load limits of diameter-to-length ratio wouldn't have a ratio that would make ultrasonic inspection unreliable.

Research test program was geared to stay within practical limits of equipment available for field inspection. However, we polished several bolt ends to see how far we could go in detecting fatigue cracks. With polished test surfaces, we picked up a minimum flaw depth of 0.040 in. with a 10-megacycle frequency. Other frequencies didn't disclose defects. Cracks, if any, under 0.040 in. made no indication on the reflectoscope screen.

SWITCHES

Continued from page 127

prene, nitrile rubber or silicone rubber with compression springs need no attention unless a leak develops. If a leak does develop, replace the packing at the first opportunity.

Internal leaks. Internal leaks, though seldom serious, may develop in certain types of gasketed porcelain bushings. Two different leak conditions originate from the arrangement of switches and potheads: (1) potheads above liquid-filled switch (2) potheads below the switch. These are considered as separate problems.

Cable oil- or compound-filled terminal chambers mounted above a liquid-filled switch may develop leaks to the switch compartment. Leaks between these compartments result in a discoloration of the liquid in the switch, the liquid being nearly water-white in new

A. P. GREEN

Plastic and Castable Monolithic Linings Give Higher Operating Efficiency . . . Lower Maintenance Costs in Watertube Boilers

Monolithic refractory linings, properly installed, give better combustion efficiency and longer service life than any other type lining.

During operation, the sections of a furnace are subjected to different conditions. Each A. P. Green product has been developed to meet the service requirements of the zone for which it is specified. A. P. Green plastic and castable furnace linings installed under the supervision of trained personnel give you the full benefit of monolithic construction, plus the advantages of "zone-rated" materials.

SUPER HYBOND is a special super duty plastic that develops high strength throughout its entire thickness . . . regardless of furnace operating temperature. It is ideal for use in spreader stoker arches and piers, behind waterwall tubes, and as a seal around tubes where they pass through the wall.

SUPER-PLASTIC . . . a super duty plastic designed for use where operating conditions are unusually severe. Gives excellent service in complete monolithic linings, side walls in furnace area, flat suspended arches and spreader stoker arches. Patching and repairing firebrick or plastic linings with SUPER-PLASTIC results in longer, more efficient service.

PLASTIC QUIK-PAK . . . a high duty plastic refractory which combines refractoriness, low shrinkage and hot load bearing strength. It is used in constructing monolithic side walls and in patching those portions of watertube boiler linings which do not require super duty plastic.

KAST-SET is a high quality refractory castable which develops a strong hydraulic bond without application of heat. Recommended for convection sections of watertube boilers, baffles, waterwall backing, linings for stacks, breechings, flues, and ducts.

KAST-O-LITE is a lightweight, insulating castable refractory for temperatures up to 2500° F. Used for monolithic linings in convection sections of boilers. Reduces heat loss. Insures closer temperature distribution and control.

For properly engineered monolithic linings call your A. P. Green distributor —he's listed in the yellow pages of your telephone directory.

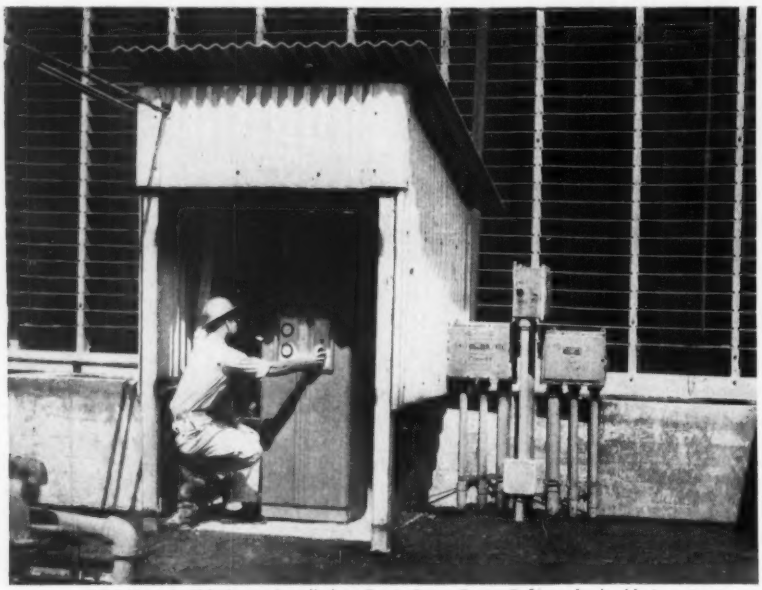
A. P. Green REFRACTORY PRODUCTS

A. P. GREEN FIRE BRICK COMPANY

Mexico, Missouri, U. S. A.

PLANTS: Mexico, Mo. • Woodbridge, N. J. • Sulphur Springs, Texas Jackson, Oak Hill, South Webster, Ohio • Phila., Pa. • Troy, Idaho In Canada: A. P. GREEN FIRE BRICK COMPANY, LTD. Toronto 15, Ontario

DISTRIBUTORS IN THE PRINCIPAL CITIES OF THE WORLD



W&T V-notch Chlorinator installed at Esso's Baton Rouge Refinery feeds chlorine at rates up to 500 lbs./24 hr. Units are available with chlorine capacities up to 2000 lbs./24 hr.

NEW W&T V-NOTCH CHLORINATORS,

used at Oil Refineries, are rugged, easy to operate and moderately priced.

Esso Standard Oil Co. has a W&T V-notch Chlorinator installed at their Baton Rouge, La., Refinery. The chlorinator, installed in a small shed open to the sun and weather, chlorinates cooling water for slime control.

This type of installation would be considered rugged service for other equipment but V-notch Chlorinators are designed for such use. They are made of materials that are completely resistant to corrosion as well as weather. They are simple to operate and to maintain. In addition, W&T V-notch Chlorinators are an attractive piece of equipment, colored green to fit into industrial color schemes.

For more information about W&T V-notch Chlorinators, send for bulletin CD-44.

WALLACE & TIERNAN INCORPORATED

25 MAIN STREET, BELLEVILLE 9, NEW JERSEY

E. R. P. CATHODIC PROTECTION
...INDIVIDUALLY DESIGNED FOR EACH APPLICATION
to prevent corrosion of buried or submerged metal structures
Write for Bulletin E-37
E-37

ELECTRO RUST-PROOFING CORPORATION

30 MAIN STREET, BELLEVILLE 9, N. J.

SWITCHES

Continued from page 174

condition. Dark pothead compounds produce a very opaque effect in insulating oil or askarel. Such a condition requires new gaskets or bushings as soon as maintenance "outage" or downtime can be arranged. In the meantime, test samples of liquids taken. Laboratory study will assist in determining existing conditions.

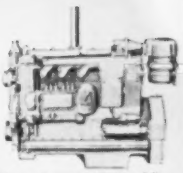
Second arrangement consists of a pothead below a liquid-filled switch. Leaks to the lower compartment or to potheads are not particularly harmful, unless the liquid in the upper compartment is askarel. But they may result in lowering the liquid in the upper compartment to an unsafe level. Askarel attacks insulating compounds and most cable insulations — consequently it is more important that gasket seals be properly made to prevent leakage.

Compartments equipped with visual-type gages are readily checked for liquid level; those with pipe plugs or hand hole covers will require the removal of small amounts of liquid through petcocks, valves or available openings by use of a thief-tube. It's important to check and know the oil levels for successful operation of electrical equipment.

Nonflammable insulating liquids. Check askarel-filled switches at three- to six-month intervals for the first year or two of operation. Test for low dielectric strength, high power factor and low megohm resistance, because a small amount of moisture or other contaminate will produce a below-normal insulation strength. If field checks indicate possibility of unsatisfactory conditions, samples from bottom, or from bottom and top of chamber, may be obtained for chemical analysis in the laboratory. (See ASTM D-901.) Filtering the askarel for a few hours through activated clay will usually restore the dielectric strength to 26 kv or higher, a satisfactory level. When Kenetron testing cables, do not exceed recommended ASA transformer test voltages because of possible polarization (dc effect) of askarel. Sixty megohms plus may be considered an objective value of insulation resistance for switch elements connected to bus or cable. Liquid power factors should preferably be kept down to 5%. Power factor values above 5% are not critical and result from (1) absorption of minor contaminants not seriously detrimental to liquid dielectric strength and (2) changes in insulation resistance to ground of associated coils or cables. Either condition may be corrected by filtering through activated clay. A white deposit may appear at low temperature

MODERN HEAVY-DUTY CAT* DIESELS FOR EVERY JOB

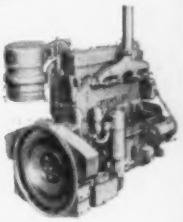
NEW D318
(Series G)
Turbocharged
175 HP†



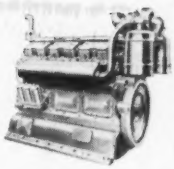
Smaller, Lighter, Lower Priced!

Keeping in line with Caterpillar's continued diesel leadership are these new Series G engines. They are designed for use in installations where space is at a premium. Both are small, light and low-priced; yet they deliver dependable power with the renowned Caterpillar durability. Both are available naturally aspirated (shown here) or turbocharged. Choice of air or electric starting system.

NEW D315
(Series G)
Turbocharged
115 HP†

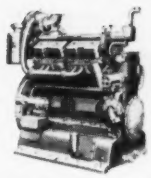


D397
with Turbocharger
650 HP†



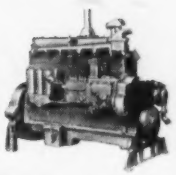
Also a Roots blown, naturally aspirated or spark-ignition engine; electric set or torque converter power unit. Air, electric or gasoline starting.

D375
with Turbocharger
430 HP†



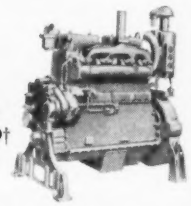
Also a Roots blown, naturally aspirated or spark-ignition engine; electric set or torque converter power unit. Air, electric or gasoline starting.

D342
Naturally Aspirated
210 HP†



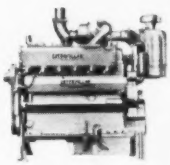
Also available as an electric set. Choice of air, electric or gasoline starting system.

D339
Naturally Aspirated
140 HP†



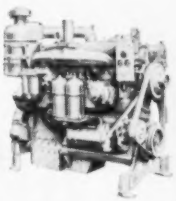
Choice of air, electric or gasoline starting system.

D337
with Turbocharger
310 HP†

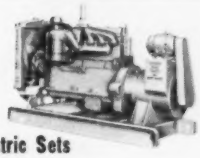


Also available as an electric set or torque converter power unit. Choice of air, electric or gasoline starting system.

D326
Naturally Aspirated
200 HP†



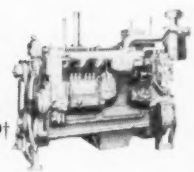
Also available as an electric set or torque converter power unit. Choice of air, electric or gasoline starting system.



Electric Sets

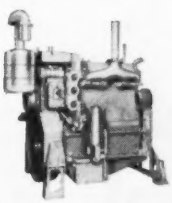
Dependable electric power, featuring the new Cat Generator, available in standard voltages, 60-cycle, in the following KW sizes: 30, 40, 60, 100, 150, 165, 200, 225, 250, 315, 350. Also available as 50-cycle and DC units.

D318
Naturally Aspirated
137 HP†



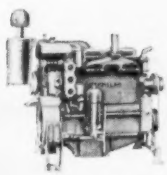
Also available as an electric set or torque converter power unit. Choice of air, electric or gasoline starting system.

D315
Naturally Aspirated
91 HP†

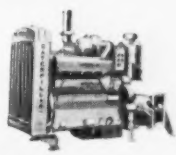


Also available as an electric set or torque converter power unit. Choice of air, electric or gasoline starting system.

D311
Naturally Aspirated
65 HP†



Also available as an electric set. Choice of air, electric or gasoline starting system.



Torque Converter Power Units

Many different arrangements are available for each of six Cat Engines. Wide choice of power units and wide choice of output shafts.

†maximum output capacity

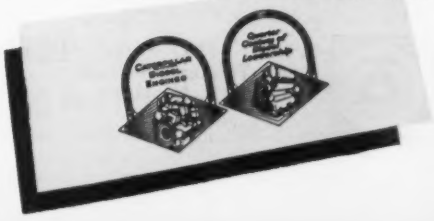
In its quarter century of diesel leadership, Caterpillar research has been responsible for advance after advance in the efficiency of these engines. The units you see here incorporate the latest diesel developments – a modern heavy-duty line that offers you hundreds of various packages to meet your requirements for work power or standby power. Whatever your original or replacement needs, you'll find exactly the unit you want in this line-up, with engines available up to 650 HP (maximum output capacity) and electric sets up to 350 KW (continuous duty). Leading equipment manufacturers can supply them in the machines they build.

For complete information about them, see your Caterpillar Dealer.

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

CATERPILLAR*

*Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

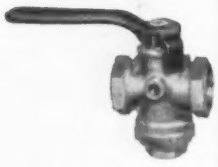


No. 107 Globe Valve

No. 1250 Gate Valve

No. 912 Globe Valve

No. 830 Step Cock



No. 1296 Gas Cock

No. 840 Quick Operating Valve

DEPENDABLE

D.T. Williams VALVES

are now produced by

DETROIT CONTROLS

GUARDIANS OF THE PIPELINES
D.T. Williams VALVES

This new association serves only to assure users of D. T. Williams Valves continued high quality and good service in the future as in the past. Direct orders and correspondence to D. T. Williams Valves, Detroit Controls Corp., 5801 Mariemont Ave., Cincinnati 27, Ohio.

5900 Trumbull Avenue
Detroit 8, Michigan

DETROIT CONTROLS
CORPORATION
Division of American-Standard

SWITCHES

Continued from page 176

in some nonflammable liquids. This precipitate, an acid neutralizer and one of the components of the liquid, is not harmful and it redissolves with an increase in temperature of the liquid during the next load cycle.

AIR SWITCHES

Air insulated switches are classified according to interrupting service as (1) no current interruption (2) magnetizing current interruption (3) load-current interruption. These switches depend primarily on clean dry air for proper insulation strength. Those installed indoors are usually in relatively clean air of near constant temperature, though metallic dusts may be a detriment in some industrial installations.

Outdoor switches with breathers must be equipped with heaters in areas where sudden and large temperature changes occur following periods of high humidity. A good maintenance program includes a study of possible abnormal weather conditions. Condensation may form on cold porcelain insulators, and must be dried or wiped off. It can usually be avoided by use of adequate heaters and maintenance through periodic checks of the heater elements and circuit continuity.

Switch types (1) and (2) are equipped with electrical interlocks and usually controlled from transformer voltages or by an auxiliary switch connected to the load side of low-voltage circuit breaker. Maintain interlock parts in a manner similar to the interlock program given for liquid-filled switches. Type (3) switches are not equipped with electrical interlocks.

Contacts. Auxiliary arc-quenching chutes or chambers are used on most air switches. Some switches are equipped with arc-quenching tubes that require replacement or servicing after 25 to 100 operations. On the other hand, deionizing chutes will need to be checked only after 20, 100 or 500 operations, depending on the applicable NEMA rating. Visible erosion of the chamber or chute indicates need for replacement. Older chutes with fiber liners are subject to warping and it may be best to replace them with new type chutes. Operate switch several times and observe entrance of auxiliary blades into current interruptors. Freedom of entry is important to correct positioning of contacts. Chute openings should not be over 1/16 in. wider than the blade. Inspect arcing tips for wear or damage in normal operations.

Main switch contacts seldom need service. However, make an occasional

LARGER SIZE RANGE

MIDWEST ELBOWS

IMPROVED DELIVERY

HEAVY WALL CARBON STEEL AND ALLOY

12" Long Radius
2¼" Wall Thickness
1¼% Chrome

20" x 10" Reducing
2" Wall Thickness
2¼% Cr—1% Mo.

STRAIGHT LONG RADIUS 90° ELLS

Nominal Pipe Size	Maximum Wall Thickness
36	1.250
30	2.000
26	2.000
24	1.500
20	1.375
18	2.250
16	2.125
14	1.750
12	2.000
10	2.000
8	1.750
6	1.000
5	.625
4	.750
3	.625
2½	.375
2	.500

These straight elbows can be furnished with LONG TANGENTS at no extra cost. All thicknesses less than those shown above are, of course, available.

The exclusive Midwest method of making all welding elbows from plate instead of tubing gives us a FLEXIBILITY OF MANUFACTURE that is much greater than by any other process. These heavy wall Midwest straight and reducing elbows are available in any material that can be secured as plate. The maximum wall thicknesses for which we now have equipment are indicated by the tables at left and right. And, because it is easier to get plate than tubing, better delivery is another advantage. Still another is the close tolerances inherent in our process.

Quality control goes beyond all code requirements. The longitudinal weld of every heavy wall elbow is completely X-rayed as standard procedure in our method of manufacture.

You will find it to your advantage to send us your inquiries.

REDUCING LONG RADIUS 90° ELLS

Nominal Pipe Size	Maximum Wall Thickness
30	2.000
26	*
24	2.000
20	2.000
18	2.000
16	1.500
14	1.750
12	2.250
10	2.000
8	1.750
6	1.000
5	.625
4	.750
3	.625
2½	.375
2	.500

Reductions to all nominal pipe sizes down to ½ large diameter. All thicknesses less than those shown above are, of course, available.
*Refer to factory.

MIDWEST PIPING COMPANY, INC.

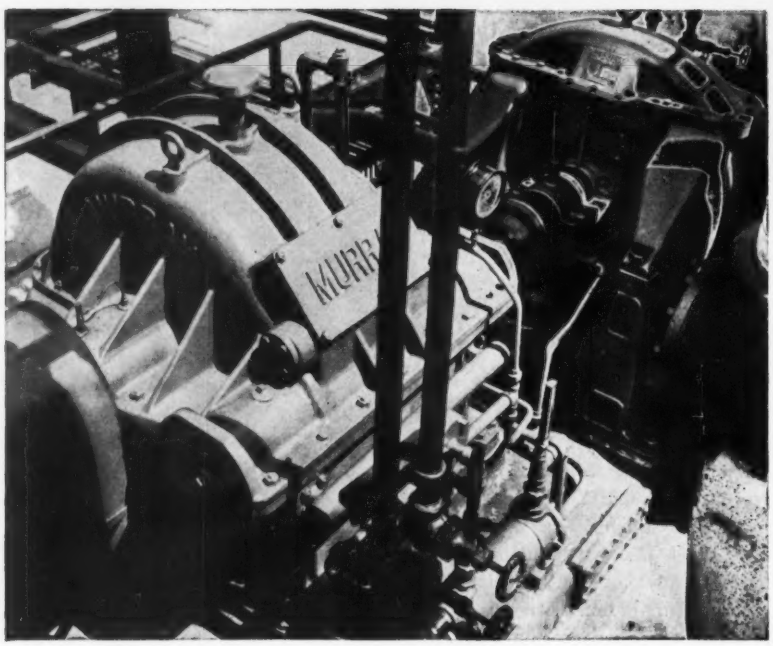
Main Office: 1450 South Second St., St. Louis 4, Mo. • Plants: St. Louis, Clifton, N. J. and Los Angeles

Sales Offices

ASHEVILLE (BOX 446, SKYLAND, N.C.)
BOSTON 27—426 FIRST ST.
CHICAGO 3—79 WEST MONROE ST.
CLEVELAND 14—616 ST. CLAIR AVE.
HOUSTON 2—1213 CAPITOL AVE.
LOS ANGELES 33—520 ANDERSON ST.
MIAMI 34—2103 LE JEUNE RD.
NEW YORK 7—50 CHURCH ST.
ONEIDA, N.Y.—282 NORTH MAIN ST.
SAN FRANCISCO 11—420 MARKET ST.

STOCKING DISTRIBUTORS IN PRINCIPAL CITIES

Murray Turbines



One of 4 Murray type U turbo-gear units installed in a southwest rubber plant still giving trouble free service after 12 years in an unprotected outdoor location. This unit drives an Induced Draft Fan requiring 425 HP at 683 RPM. The turbine speed is 3500 RPM.

● Murray turbo-gear units for mechanical drive are right at home in difficult outdoor installations. Fans, pumps, compressors, and many special types of slow speed machines are among the long list of installations powered by Murray turbo-gear units. Murray gears are of the Herringbone or Double Helical type and all are pressure lubricated at the point of tooth contact.

MURRAY IRON WORKS COMPANY

BURLINGTON, IOWA

Builders of Steam Power Equipment for Three Quarters of a Century

SWITCHES

Continued from page 178

inspection for alignment through observation windows.

Mechanical interlocks between switch operating handles and fuse compartment doors may be damaged by abuse. Interlocks, such as Kirk locks on switch-operating handles, should be kept free by oiling or greasing. Check their operation at each periodic inspection and adjust them if necessary.

Cable potheads on air switches are serviced in the same manner as those on liquid-filled switches except that no switch liquid can leak to the pothead.

When overload or current-limiting fuses are a part of the switch assembly, fuse housings should be inspected for corrosion of copper parts and for proper clip contact. If abnormal overloads have been experienced, fusable elements may need replacement since they can be damaged by overheating without complete burnout or clearance. At the same time, insulators should be wiped clean. If fuses are of the hook-stick type, one pull out and return will help to insure good clip contact.

Lightning arresters are located in some switch housings either above or below the switch assembly. A test of circuit continuity by the use of an ac or dc test set will help to evaluate the condition of the arresters.

CORROSION

Continued from page 81

nitrogen to form ammonia. This, in turn, neutralizes the nitric acid and returns pH to normal.

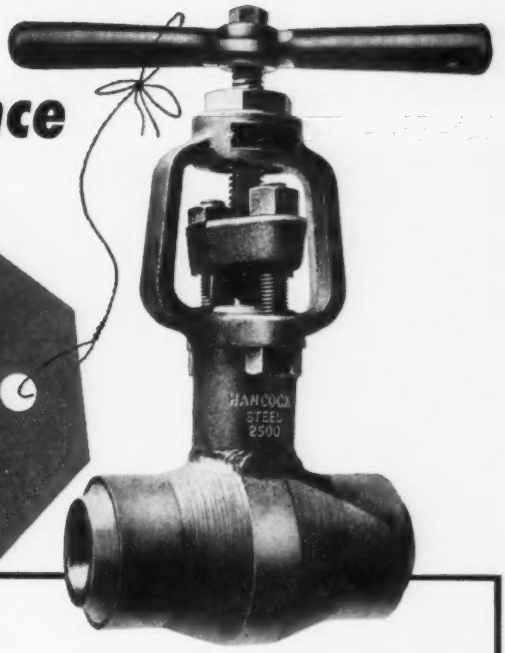
Irradiation effects. It is difficult to run corrosion tests under irradiation. Preliminary and scattered data indicate that pile radiation is not detrimental and in some cases may even prove to be beneficial.

Water tends to decompose under radiation. But the back reaction (recombination of hydrogen and oxygen) proceeds rapidly and completely in pile. So there is little opportunity for oxygen freed by dissociation to react with material in the reactor core. Hydrogen, released by simple metal-water reaction, helps promote recombination. Pile radiation has not yet produced any corrosive effect of consequence.

With gamma radiation, the opposite effect is observed. Recombination proceeds more slowly. In a steam cycle system, where there is no free hydrogen build-up, some oxygen will be present. Any gamma radiation tends to accelerate oxygen corrosion. So all steam generators, exposed to high levels of gam-

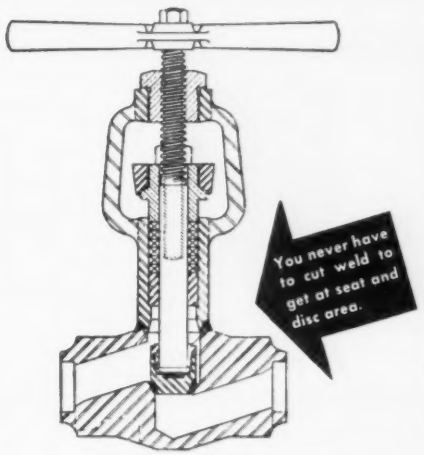
Cut valve maintenance up to 75%

Install HANCOCK 1500# and 2500# Steel Valves



• Every power plant maintenance man will agree that a lot of valuable time is lost when hours must be spent in servicing a single high pressure valve. That is why Hancock 1500# and 2500# Steel Valves are preferred for high-temperature steam lines. They rarely require attention, but when maintenance is needed, the work takes as little as one-fourth the time ordinary high pressure valves demand. Hancock Valves stay in the line for servicing. There is no danger of ruining internal parts. The bonnet weld is permanent – never has to be cut to get at the seat and disc area.

Most design and operating engineers in modern steam plants specify these high pressure Hancock Valves with maintenance requirements in mind. There is no bonnet joint to leak, no gasket to leak, no seat insert to leak! In design, in quality, in construction – in every respect – Hancock 1500# and 2500# Steel Valves have every feature essential to protect personnel, plant and service to customers. So, when you replace high pressure valves, remember that *when Hancocks go in, valve costs go down!*



SIZES: ¼" through 2". Outside screw and yoke.

SERVICE RATINGS: Screwed and socket weld ends: For all pressures up to 2500 psi at 1050° F., O.W.G. 6000 psi—100° F.

Flanged Ends: For all pressures up to 1500 psi at 900° F., O.W.G. 3600 psi—100° F.

Integral hard faced seats, hard faced discs.

CALL YOUR INDUSTRIAL SUPPLY DISTRIBUTOR for help in meeting your needs for revalving projects and new construction. You can depend on his recommendation to save you time, trouble and expense.

In Canada: *Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario*

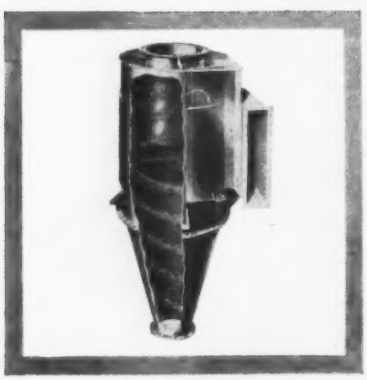
HANCOCK VALVES

A product of **MANNING, MAXWELL & MOORE, INC.** Watertown 72, Massachusetts

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'ASHCROFT' GAUGES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, *Stratford, Conn.* 'HANCOCK' VALVES, *Watertown, Mass.* 'CONSOLIDATED' SAFETY RELIEF VALVES, *Tulsa, Oklahoma.* AIRCRAFT CONTROL PRODUCTS, *Danbury, Conn. and Inglewood, Calif.* "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Mich.*

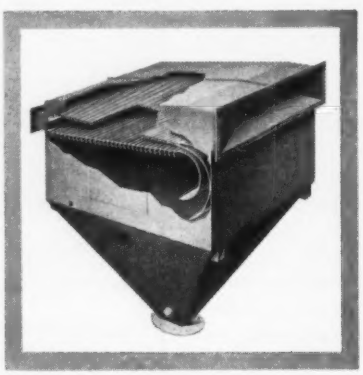
How Buell's Exclusive Rapping Mechanism delivers Extra Dust Collection Efficiency

ORDINARY RAPPING
Shakes dust from collecting electrodes. Re-entrainment of cloud of dust reduces precipitator efficiency
BUELL RAPPING
Shears dust from collecting electrode surface, minimizes scattering and re-entrainment



Buell Cyclones offer two "extra-efficiency" advantages: (1) exclusive Shave-off which harnesses double-eddy and puts it to work, and (2), large diameter design which eliminates clogging.

Complementing the extra efficiency of rapping in Buell "SF" Electric Precipitators, the unique Spiralectrodes add further efficiency through 50% to 100% higher electron emission, constantly accurate spacing, longer electrode life.



Buell's Low Resistance Fly Ash Collector combines top efficiency with low draft loss, for natural or forced draft installations. Ideal for boilers from 100 to 2000 BHP.

For more specific data about Buell's *extra efficiency*, write Dept. 50-D, Buell Engineering Company, 70 Pine Street, New York 5, N. Y.

buell®

MECHANICAL ELECTRICAL

Experts at delivering Extra Efficiency in
DUST COLLECTION SYSTEMS

CORROSION

Continued from page 180

ma radiation need an oxygen scavenger such as sodium sulfite or hydrazine.

Temperature effects. At temperatures used in pressurized - water reactors, changes of 50 to 100 F have little effect on corrosion of ferrous materials. These alloys behave well in water in the 500 F to critical range, and in steam in the 500 to 700 F range.

Temperature effects cause greatest concern in fuel elements because of high heat fluxes. An autocatalytic reaction can occur with fuel-element cladding alloys, which form an adherent oxide seal. Temperature drop across this film increases as the oxide grows in thickness. Temperature of corroding surface and rate of corrosion are increased.

Common types of corrosion. Most of the conventional types of industrial corrosion are encountered. Relative importance to the system is different because nuclear equipment must be accessible and free from radioactive contamination at all times. Corrosion failure of any type is of concern because of repair, maintenance troubles.

One special corrosion problem is encountered with the boiler. Steam-generator tubes are in contact with both the primary coolant and the secondary boiler water. Tube material must be noncorrosive in pure water as well as in boiler feedwater containing chlorides. Search is still underway for a satisfactory material for this service. It must corrode at very low rates in pure pressurized water and resist stress cracking in chloride solutions.

Pitting of boiler tubes is also a serious problem. Any opening in the tube allows radioactive primary coolant to enter the steam system. Sensitive radioactivity detectors warn of any primary coolant leakage.

Structural sections and piping thickness are great enough so that corrosion failure outside of the steam generators is almost unheard of. Usually conditions in a pressurized-water reactor are not conducive to pitting.

Galvanic corrosion is not a problem because of the very high resistivity of the coolant. However, in crevices, deep annuli and under deposits, local water conductivity can increase enough to cause galvanic corrosion.

Many metals, including the stainless steels, increase in size with corrosion. Enough allowance must be made to prevent seizure between parts which move occasionally. Intergrowth of oxide film can bridge a gap of 0.001 to 0.002 in., even though average increase in oxide thickness is only a few micro-inches.

Selecting materials. Reactor materials must be carefully screened for

You get MORE CAPACITY with a FANMIX BURNER

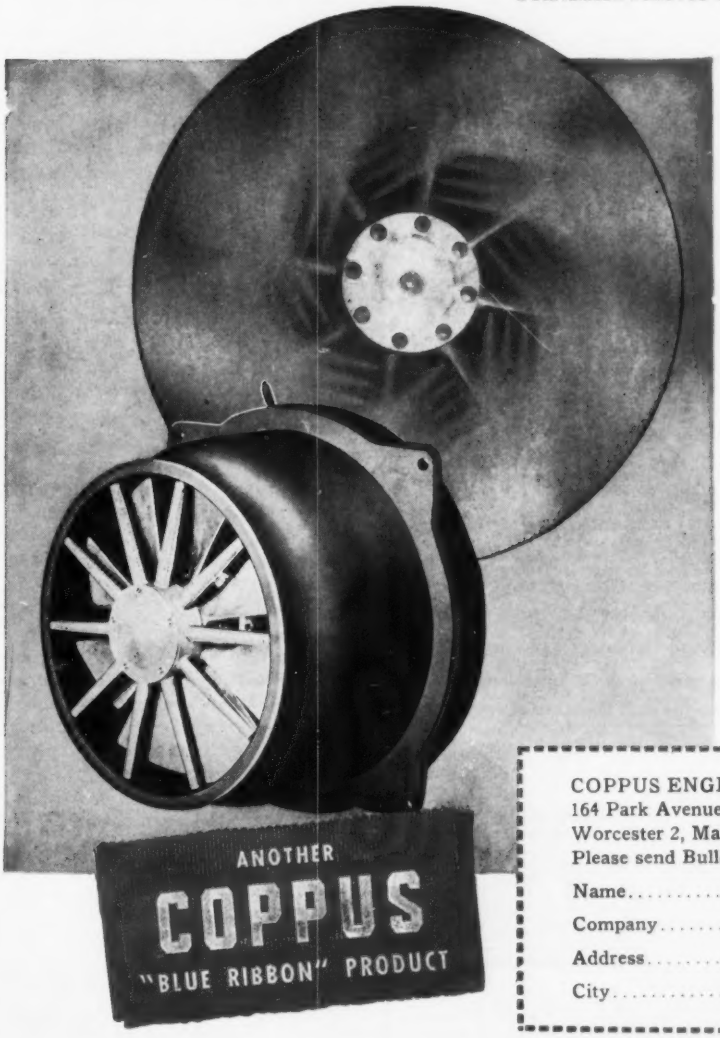
Increase Boiler Ratings On Present Or Planned Equipment

In all types of Coppus-Dennis FANMIX Burners — straight gas or combination gas-oil — we utilize the energy of the fuel under pressure to drive the burner fan and deliver air in the proper proportion to the fuel flow. This exclusive "pinwheel action" *mechanically* mixes fuel and air in exactly the right proportions for truly radiant, non-luminous heat.

The result is uniform temperature everywhere in the combustion chamber — no drifting "hot spots" — and complete combustion under all conditions. That's why you can release more heat into your present furnace — why in new installations you get more heat into smaller furnace space.

FANMIX Saves On Both Old and New Installations

FANMIX can easily be operated with your present furnace and stack, requiring only minor changes in other equipment. Or if you're planning on new boilers, remember that FANMIX relieves the furnace from the burden of mixing, creates its own forced draft and takes smaller pipe sizes, Which means you can plan on reduced combustion space, less stack, no forced draft equipment and lower installation costs all around.



Get the Whole Story

Coppus engineers FANMIX Burners to meet individual requirements, providing complete control over heat pattern and combustion . . . Learn more about how "pinwheel action" can step up *your* boiler performance to peak efficiency and economy — as it is doing throughout industry. Send for Bulletin 410-6. Coppus Engineering Corp., Worcester 2, Mass. Sales Offices in THOMAS' REGISTER. Other Coppus "Blue Ribbon" Products in BEST'S SAFETY DIRECTORY, CHEMICAL ENGINEERING CATALOG, REFINERY CATALOG, and MINING CATALOGS.

COPPUS ENGINEERING CORPORATION
164 Park Avenue
Worcester 2, Mass.
Please send Bulletin 410-6 to:

Name.....

Company.....

Address.....

City.....Zone.....State.....

How many years of frictionless service do you get from

ammonia packing

Chesterton 444, is the most famous of refrigeration packings. Frictionless operation is obtained by means of an oil seal. Elastic backing rings surrounding the bearing-metal alloy rings provide resiliency. As each metallic ring seals on a film of oil, destructive gland pressure is not needed. The metal rings are soft enough to machine themselves to rod or shaft imperfections. The set of 444 rings is made to bend open and slip over the rod or shaft without dismantling the machine. Uninterrupted service of 5 or more years is common on pumps or compressors handling ammonia, freon, CO_2, steam, brine, gas or air. The cost is reasonable and delivery prompt. Please send for literature.

PACKING Chesterton SERVICE

A. W. CHESTERTON CO. • EVERETT 49, MASS.
America's Oldest Manufacturer of Mechanical Packings

CORROSION

Continued from page 182

corrosion resistance, product release rate and composition of corrosion products. Circulating test loop of the type illustrated, p 81, is used for this purpose. Summary of the pertinent properties of a cross section of alloys for nuclear work, located under the test loop drawing, is useful as a general selection guide. Additional data are available in the open literature.*

What's ahead? Primary concern in early stages was with getting nuclear plants running and not with cost or availability of materials. The best commercial products were used. Engineers worried about corrosion products and not loss of structural material. We are now embarked on an era where the push is on to build large numbers of plants at more reasonable cost. One carbon steel generator is now in use, and a second is being designed with carbon steel throughout the primary coolant system, except for the stainless clad pressure vessel. Trend to make atomic power more commercial will put increased pressure on reducing manufacturing and operating costs. Search will be intensified for materials that are less expensive to buy and fabricate, and for water purification systems cheaper to construct and operate.

*R U Blaser and J J Owens, *Special Corrosion Study of Carbon and Alloy Steels*, ASTM Symposium on High Purity Water Corrosion, June, 1955
B Lustman and F Kerze Jr, *The Metallurgy of Zirconium*, NNES Division VII, Volume 4. Published by McGraw-Hill Book Company, 1955.

MARMADUKE

Continued from page 148

"BILGEWATER on those Venezuelan throttle pullers. I'll tell you hammer-and-chisel mechanics about the time I cured a sick steam engine in Brazil and got treed by some tough customers before I could do it."

We all listened. Marmy blasted away in his foghorn voice.

"Back in 1928 I signed with a large firm for a hitch at their new rubber plantation in Brazil. About 2½-million acres of wild jungle country were being cleared for that project.

"First shipload of American technicians had left the year before. Once there, they'd hired native Indians to clear the land, help build houses for employees and factory buildings for our arrival. We loaded all the power plant equipment aboard ship in Hoboken. Most of it was rebuilt reciprocating machinery, torn out of defunct stationary plants and old merchant ships. (Continued on page 186)

ALL FORGED STEEL

Edward UNIVALVES

Lower Pressure Drop 25-50% with Straight-Thru Flow

As shown photographically here, the streamlined internal contours and the inclined stem construction of the Edward Univalve give straight through flow — which careful laboratory tests have shown to result in pressure drop 25 to 50% lower for Univalves than other globe valve types. Turbulence, too, is greatly lowered by these streamlined contours. And lowering turbulence lengthens valve life by eliminating vibration, the principal cause of wear in small globe valves.

But lower-pressure drop and less turbulence are not the only reasons the Univalve has become an industry standard for tough high pressure, high temperature services. Here are just a few of the benefits which add up to longer life and lower maintenance for this outstandi[illegible] all Forged Steel Valve.

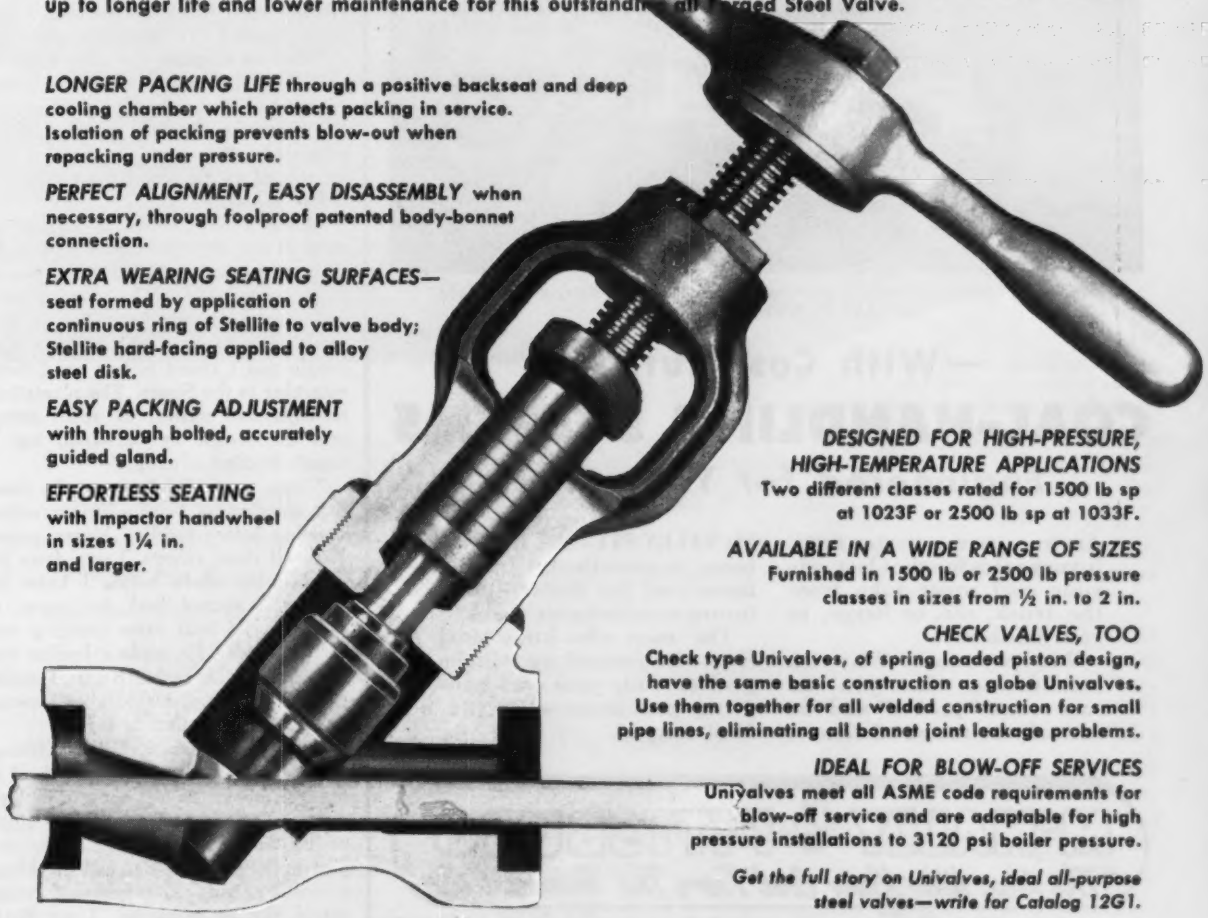
LONGER PACKING LIFE **through a positive backseat and deep cooling chamber which protects packing in service. Isolation of packing prevents blow-out when repacking under pressure.**

PERFECT ALIGNMENT, EASY DISASSEMBLY **when necessary, through foolproof patented body-bonnet connection.**

EXTRA WEARING SEATING SURFACES— **seat formed by application of continuous ring of Stellite to valve body; Stellite hard-facing applied to alloy steel disk.**

EASY PACKING ADJUSTMENT **with through bolted, accurately guided gland.**

EFFORTLESS SEATING **with Impactor handwheel in sizes 1¼ in. and larger.**



DESIGNED FOR HIGH-PRESSURE, HIGH-TEMPERATURE APPLICATIONS
Two different classes rated for 1500 lb sp at 1023F or 2500 lb sp at 1033F.

AVAILABLE IN A WIDE RANGE OF SIZES
Furnished in 1500 lb or 2500 lb pressure classes in sizes from ½ in. to 2 in.

CHECK VALVES, TOO
Check type Univalves, of spring loaded piston design, have the same basic construction as globe Univalves. Use them together for all welded construction for small pipe lines, eliminating all bonnet joint leakage problems.

IDEAL FOR BLOW-OFF SERVICES
Univalves meet all ASME code requirements for blow-off service and are adaptable for high pressure installations to 3120 psi boiler pressure.

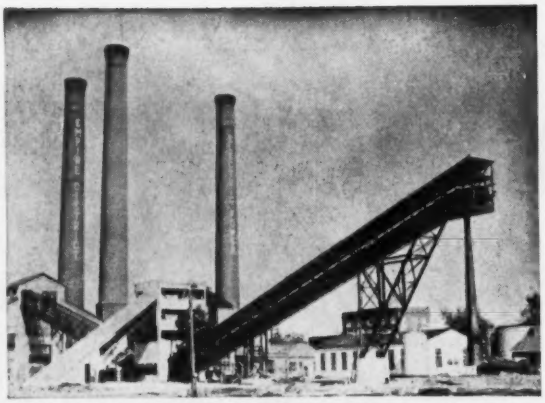
Get the full story on Univalves, ideal all-purpose steel valves—write for Catalog 12G1.

Rod through Univalve demonstrates straight thru flow of this valve.

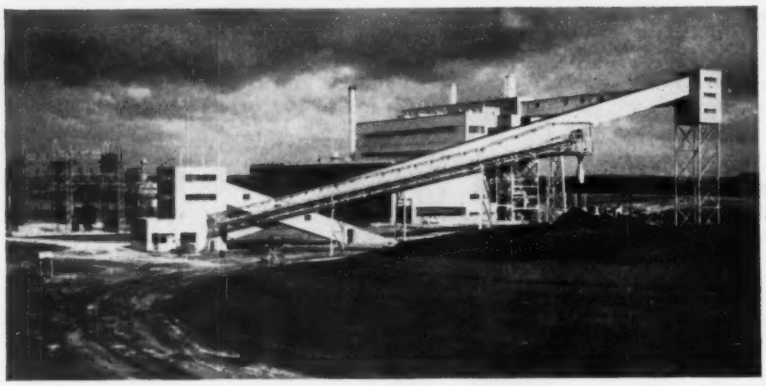
Edward Valves, Inc.
Subsidiary of ROCKWELL MANUFACTURING COMPANY
1230 West 145th Street, EAST CHICAGO, INDIANA

Another Product

EARN EXTRA PROFITS IN SAVINGS



McNally Pittsburg developed this 250 ton per hour system for the EMPIRE DISTRICT POWER & LIGHT CO.



McNally Pittsburg assisted in developing this 300 ton per hour system for the KANSAS POWER & LIGHT CO.

—With Cost-Cutting

COAL-HANDLING SYSTEMS

Engineered for Your Plant

Are you paying "extra fare" luxury rates for that last ride your coal must take from the truck, car, or barge, to your bunkers?

Why pay more? Why risk breakdowns, when you can *save* extra "profits" and be sure of year-round efficiency.

McNALLY PITTSBURG Systems automatically handle more coal per dollar—minimum maintenance costs.

The men who know coal from the ground up will be glad to study your coal-handling problems with you. Mail coupon.

McNALLY PITTSBURG

"The Men Who Know Coal From The Ground-Up"

McNally Pittsburg Mfg. Corp., Dept. PO, Pittsburg, Kansas
Gentlemen: Send more information on your Coal-Handling Systems.

Name_____ Title_____

Company_____

City and State_____

MARMADUKE

Continued from page 184

"Three weeks later we arrived at the river port of Belterra, 700 miles up the Amazon on the Rio Tapajos. I was in charge of erecting the power plant machinery. My job would be finished when I had the plant shipshape and ready for the chief engineer.

"The boilers were old 160-psi cross-drum watertube jobs. They were built in 1906 and came out of a New York City power plant. Electricity was to be generated by three alternators, each direct connected to a steam engine. The three vertical cross-compound steam engines had overhung cranks with flywheel and alternator between the engine's frame. Each had a 17-in. high-pressure and a 36-in. low-pressure cylinder. Engine's stroke was 30 in. At 160 rpm, those old stationary engines cranked out 760 indicated hp.

"First we installed the heavy machinery, then the boilers. All the heavy piping had been fitted and prepared in the States, ready to hook up. With plenty of natives to do the coolie work, we started up the power plant a month before schedule.

"After a few weeks of operation, most of the bugs seemed to be licked. So one Sunday morning, with everything running OK, I borrowed a rifle and started for my first hike up the river. There were wild boar in the jungle and I aimed to bag one before returning to the States. The plantation manager had warned us about going into the jungle by ourselves, but I wasn't worried.

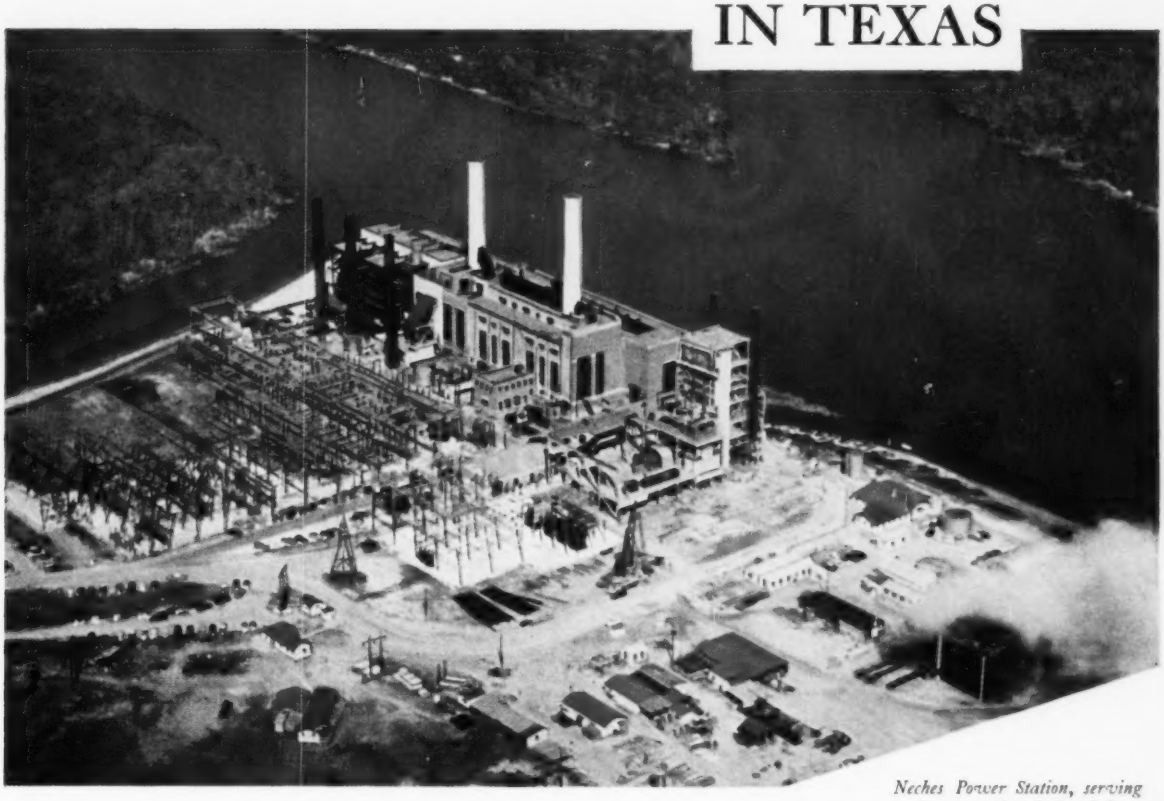
"There were wild ducks on the river that morning, so I did a little practice shooting before tackling bigger game. With all those targets, I was down to my last two shells before I knew it. Just as I started back for camp, a snarling wild boar came charging out of the jungle. He made a beeline for me, clacking his tusks. Before I could take aim, four of his buddies showed up. That was no time to argue.

"Don't ask me how, but next thing I knew I was propped in the fork of a big tree, about ten feet above my playmates. They started a game of ring-around-the-rosie beneath me. They circled that tree, snarling, and clacking, evidently giving a preview of what they'd like to do to me. I got dizzy looking at them.

"Suddenly I started to itch all over. The tree was alive with large black ants—and so was I! They were inside my clothing, biting the hell out of me. Those circling pork sandwiches below had me so absorbed that I hadn't noticed my new friends.

(*Continued on page* 190)

Up-and Up-and Up-Go POWER DEMANDS IN TEXAS



Neches Power Station, serving a fast-growing industrial region, is situated on the south bank of the Neches River, near Beaumont, Texas.

During 1956 the installation of an outdoor unit comprising a turbine generator with a capability of 111,000 kilowatts, a 700,000 pounds per hour boiler and associated water cooling tower was completed at the Neches Power Station of Gulf States Utilities Company. A second such unit is due for completion in 1958.

These are the seventh and eighth units at the Neches Station which first went into operation in 1926 with a single 20,000 kilowatt generator and two 1,530 horsepower boilers. The present capability of the station is 376,000 kilowatts and 3,000,000 pounds of steam per hour.

The initial installation and all subsequent additions were designed and built by Stone & Webster Engineering Corporation.

Write or call us for information as to how our experience may be of assistance to you.

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY of STONE & WEBSTER, INC.

New York Boston Chicago Pittsburgh Houston San Francisco Los Angeles Seattle Toronto

you, too, could spend a lifetime studying **HEAT EXCHANGER TUBE** problems...

but there's an **easy** way to save yourself that kind of work

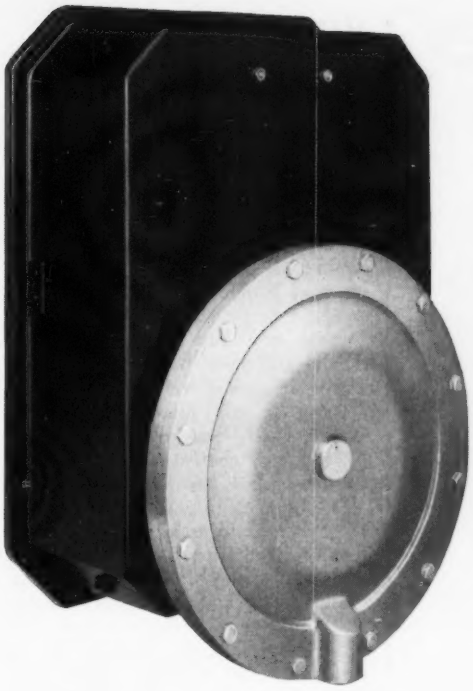
Simply pick the brand of Heat Exchanger Tube that starts out in life as a CONTINUOUS-CAST billet . . . Scovill Phosphorized Admiralty. Only in Scovill's unique continuous casting process do *many* carefully controlled melts of alloy BLEND together in the casting process to produce such SOUND and UNIFORM billets for subsequent hot extrusion and cold-drawing into Heat Exchanger Tube. Exceptional uniformity of chemical composition and uniform distribution of the inhibitor (phosphorus) mean longer tube life.

Scovill Manufacturing Company, Mill Products Division, 99 Mill Street, Waterbury 20, Connecticut. Phone PLaza 4-1171.

simply put it up to... SCOVILL

HEAT EXCHANGER TUBE FOR APPLICATIONS FROM MARINE TO PETROCHEMICAL . . . FROM COMPRESSOR INTERCOOLERS TO "CAT-CRACKER" EXCHANGERS . . . IN THESE POPULAR ALLOYS
Phosphorized Admiralty • Admiralty • Arsenical Admiralty • Naval Brass • Red Brass, 85% • Deoxidized Copper
Arsenical Copper • Cupro Nickel 10%—20%—30% • Aluminum Brass • Aluminum Bronze, 5% • Muntz Metal • Duplex Tube

ISC57



BEST...AND SIMPLEST WAY TO MEASURE

1- *Furnace Pressure*

2- *Gas Pressure*

3- *Air Flow*

Taylor DIAPHRAGM MANOMETER

is easy to maintain . . . stays in calibration

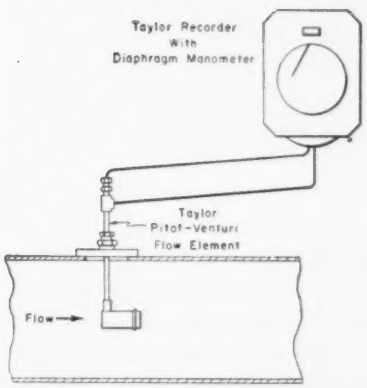
HERE IS Taylor's answer to problems of measuring furnace pressure, gas pressure, or (as shown here) air flow. This low-pressure Diaphragm Manometer is designed for measuring vacuum, pressure and differential pressure where the range does not exceed 4″ water and static pressure is no more than 5 psig.

It's a large 302 stainless-steel convoluted diaphragm in an aluminum housing—built to give rugged, reliable service without excessive weight. Overrange protection to 30 inches of water.

Simplified Manometer zero adjustment accessible within instrument case . . . compensation for changes in ambient temperature . . . easily adapted to range changes.

- Excellent repeatability
- Little maintenance
- Easy calibration
- Stays in calibration.

Ask your Taylor Field Engineer, or write for **Bulletin 98175.** Taylor Instrument Companies, Rochester, N.Y., and Toronto, Canada.



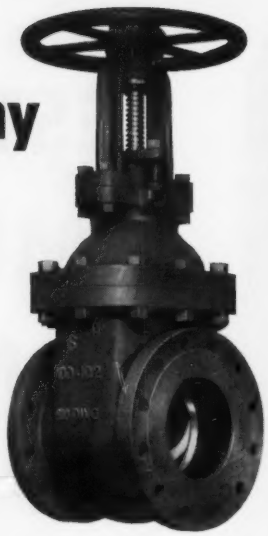
Taylor Instruments

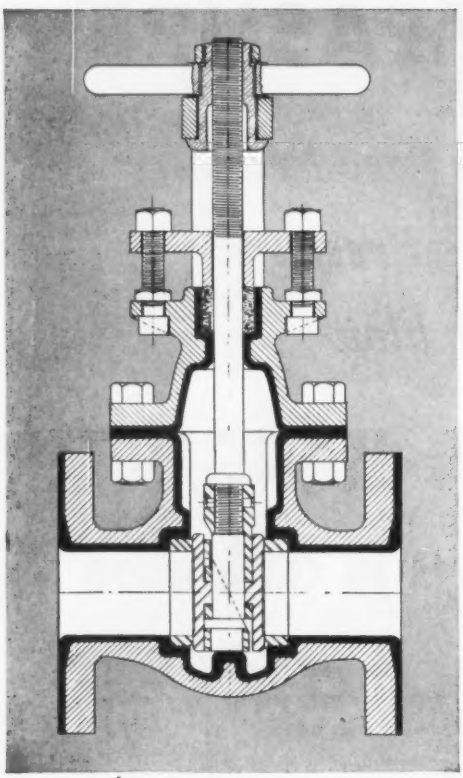
MEAN

ACCURACY FIRST

VISION · INGENUITY · DEPENDABILITY

FOR double economy in corrosive service





• *Darling rubber-lined iron body gate valves, with special alloy working parts, offer trouble-free corrosive service and big savings. Available in rising stem, cylinder or motor operated, or quick-opening types.*

HERE'S a Darling gate valve that can save you plenty of dollars in corrosive services up to 180° F. This is an iron body valve with a hard rubber lining permanently bonded to all exposed interior surfaces, and suitable for working pressures up to 150 pounds.

Equally important, this valve features Darling's *fully revolving double disc parallel seat principle* which is unexcelled for trouble-free performance, tight closure, low maintenance and long life.

Weigh these facts and potential savings, then write for complete data on these job-proved rubber-lined iron body valves.

DARLING VALVE & MANUFACTURING CO.
Williamsport 8, Pa.
Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ont.

MARMADUKE

Continued from page 186

"I had been saving my last two shells to get a boar. But now I knew I might need them to call for help. Just when I was ready to go nuts from those ants, I heard a shot downriver. Not to waste my answering shot, I took a bead at the bow of one of those circling boars below, and hit him in the poopdeck instead. But my shot had been heard, because soon Burt Commiski, my assistant, and some Indians showed up. They were well-armed and started blasting at my four-legged friends. When I finally tumbled out of that tree, I was plenty chewed up and felt like an overworked bar-room dartboard.

"Going back to camp, Burt told me the boss sent them for me soon as he learned I had left the camp alone. Besides, he added, they were having trouble in the power plant and needed me pronto.

"Back in camp, the plantation doctor worked me over with some magic salve that took the sting out of my perforated hide. While he worked on me, I doctored myself with my own brand of jungle remedy. After a few hours, the world looked more cheerful and I headed for the power plant down by the river.

"Inside, I found the plantation manager and the engineers standing around the No. 2 vertical-compound steam engines. Pete Mulry was heating up the big blow torch. 'Hold everything,' I yelled when I saw what he was up to. 'Let's see if we can't dope out a better way to do that.'

"The chief explained that the engine's 10-in. overhanging hp crankpin had gotten hot that morning. After stopping her, they discovered that the crankpin bearing wasn't getting oil. Reason was that the brass bushing, pressed into the pin's end, had turned in its bore. Crank was lubricated through that bushing. Oil was dispensed, by a center oiler, through a telescope rod that reciprocated with the crank. So when the bushing slipped, it shut off the holes that fed oil from the pin's center, up through the pin's walls, into the bearing.

"The 3-in. bushing was pressed into a blind hole. In trying to remove it, the boys had tapped out the bushing with a 2-in. tap. Then they were going to screw in a bolt for removing the bushing against a strongback. But just as the tap got home, it broke off flush with the crankpin's end. Having to remove a bushing from a blind hole with its outside end plugged by a broken tap complicated the problem. Pete Mulry was going to anneal the tap with the blow torch, drill it out,

Midwest institution gets lesson in turbine lubrication

. . . learns advantages of using NONPAREIL *Turbine Oil*

In 1939, a Midwestern institution installed a 350 kw. turbine. In less than a year, considerable difficulty was experienced with oil sludge and deposits. A Standard Oil Company industrial lubrication specialist recommended switching to NONPAREIL Turbine Oil as a solution to the problem. He supervised the draining and cleaning of the turbine system and the installation of NONPAREIL Turbine Oil.

The turbine, equipped with NONPAREIL, was started up in June, 1941. Periodic tests showed that the neutralization number of the oil was never above 0.06 mg. KOH/g. Having had this experience with NONPAREIL Turbine Oil, when a new 750 kw. turbine was installed in 1947, only NONPAREIL was considered. In 1954 when a 1,000 kw. turbine replaced the 350 kw. one installed in 1939, NONPAREIL was again the first choice of the institution management.

The reason why NONPAREIL can deliver this kind of performance is this: NONPAREIL is refined from finest quality oil. An oxidation inhibitor is added to NONPAREIL which checks acidity formation even better than natural inhibitors normally found in oil. The inhibiting of acid formation in NONPAREIL is so complete Standard Oil can guarantee that the neutralization number of NONPAREIL Turbine Oil will never exceed 0.15 mg. KOH/g. for the life of the turbine.

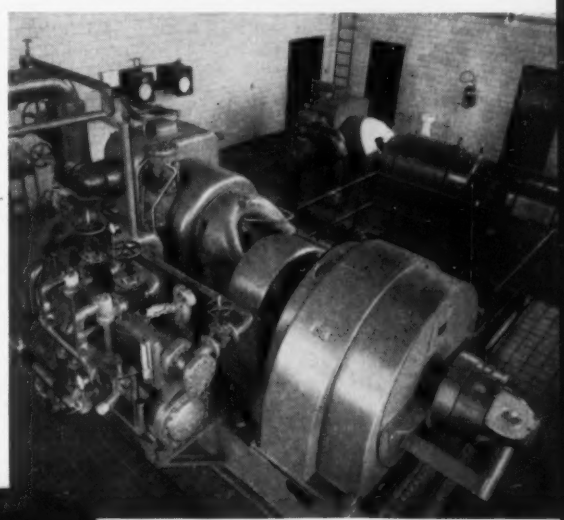
More facts about NONPAREIL Turbine Oil are readily at hand. Get them from your nearby Standard Oil industrial lubrication specialist. There is one of these men in any of the 15 Midwest and Rocky Mountain states. Or write Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

Quick facts about

NONPAREIL TURBINE OIL

- Does not form acids.
- Does not sludge.
- Maintains good demulsibility.
- Guaranteed to last the life of the turbine.

A 1,000 kw. and a 750 kw. turbine provide power to this Midwest institution. Both have used NONPAREIL Turbine Oil since the first day they went into service.



Donald Cripps (right), Standard Oil lubrication specialist, hands John Edyvean, plant superintendent, framed guarantee for NONPAREIL Turbine Oil. Providing technical service on lubrication problems is work for which Don Cripps is well qualified. He's been doing it for nine years at Standard. In addition, he has an engineering degree from Michigan State University and is a graduate of the Standard Oil Sales Engineering School.

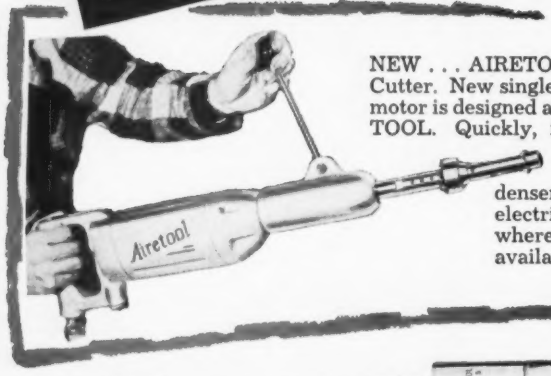
STANDARD

STANDARD OIL COMPANY
(Indiana)

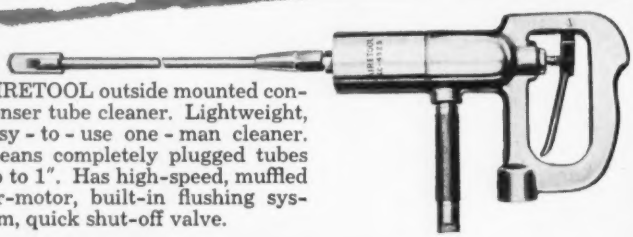
AIRETOOL

makes every type of tube maintenance tool

Look no further than AIRETOOL for dependable, cost-saving tube maintenance equipment. Precision made Airetool tube cutters, cleaners, expanders, accessory and specialty tools meet **every** tube maintenance need. Save time and money on **every** job.



NEW . . . AIRETOOL Internal Tube Cutter. New single-stage, air-driven motor is designed and built by AIRETOOL. Quickly, inexpensively removes damaged or leaky condenser tubes. Optional electric motor for use where air supply is not available.



AIRETOOL outside mounted condenser tube cleaner. Lightweight, easy - to - use one - man cleaner. Cleans completely plugged tubes up to 1". Has high-speed, muffled air-motor, built-in flushing system, quick shut-off valve.

AIRETOOL Automatic Tube Expansion Control . . . automatically, accurately rolls tube joints to proper tightness. Portable unit goes right to job site.

AIRETOOL Tube Removal Tools are great for retubing a bundle. Quickly and efficiently remove tubes and tube stubs from condenser tube sheets.

AIRETOOL

MANUFACTURING COMPANY

SPRINGFIELD, OHIO

BRANCH OFFICES: New York, Chicago, Tulsa, Philadelphia, Houston, Baton Rouge.

Write for illustrated literature on condenser tube maintenance tools. Ask for Bulletin #59.

REPRESENTATIVES in all principal cities of U.S.A., Canada, Mexico, South America, England, Europe, Puerto Rico, Italy, Japan and Hawaii.
EUROPEAN PLANT: Vlaardingen, The Netherlands.

CANADIAN PLANT: 57 Spalding Drive, Brantford, Ont.

MARMADUKE

Continued from page 190

then draw out the bushing. But I didn't like the idea of heating that crankpin because it was a shrink fit into the crank disk.

As I stood there, hands in my pockets, listening to the chief, I kept racking my brains for an idea. That job had me treed again, temporarily. Suddenly, I became conscious that I was toying with the remaining rifle shell in my pocket.

" 'Land ahoy,' I yelled, 'I've got it. Maybe I didn't bag a boar this morning, but here's where I bag a bushing.'

"I asked for some shotgun shells. The plant manager looked at me as if I had stripped my gears from being in that tree too long. When Pete Mulry got the shells, I tore apart enough of them to fill the space in back of the broken tap with gun powder. The 10-in. crankpin had two $\frac{3}{8}$-in. oil holes drilled to the brass bushing in its center. I had the boys insert a $\frac{3}{8}$-in. drill into the hole nearest the crank disk and drill through the brass bushing wall that had shut off the oil supply. The hole was then tapped and plugged with a pipe plug, after I poured it full of gun powder. We drilled a $\frac{1}{8}$-in. hole through the plug for a fuse.

"Next I tamped gun powder through the broken tap's flutes, then packed the flutes tight with moistened paper. After propping some 2-in. planking at the crankpin's end, in the line of fire, I heated a long bent wire 'til it was red hot at one end and shoved it into the tiny hole we had drilled in the pipe plug. **W-H-A-M!**

"You'd have thought an ammo dump had blown up. When the smoke cleared away, we found the bushing had not only blown out of the hole, but that it went right through the 2-in. planking like a cannon ball.

"Our machine shop made a new 3-in. bushing and pressed it in tight. Then they drilled out the two bushing oil holes, through the crankpin holes, and hooked up the central oiler. When the engine was put back on the line, the plantation manager took me to his home for dinner.

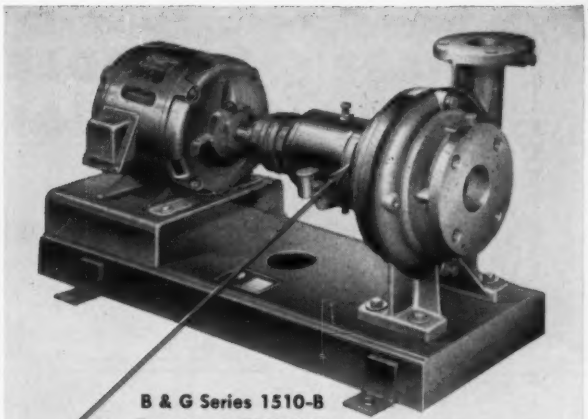
" 'Mr Surfaceblow,' he said, handing me a glass of gin and tonic, 'after hearing how those wild boars and ants treated you this morning and then seeing how well you handled that bushing problem with gun powder, I'll give you some good advice.'

" 'Fire away,' I said.

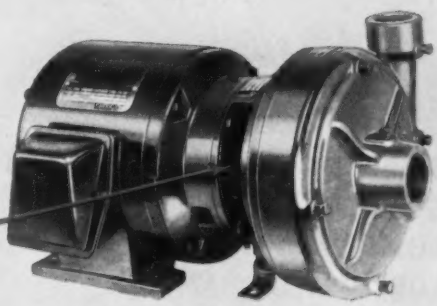
" 'From now on,' he laughed, 'stick to your own ball park. Stay the hell away from the jungle and do all your shooting in power plants. That's where you seem to sock a home run every time you step to the plate.' "—STEVE EONKA

A great line of pumps
all equipped with the

B&G
TROUBLE-PROOF SEAL ASSEMBLY

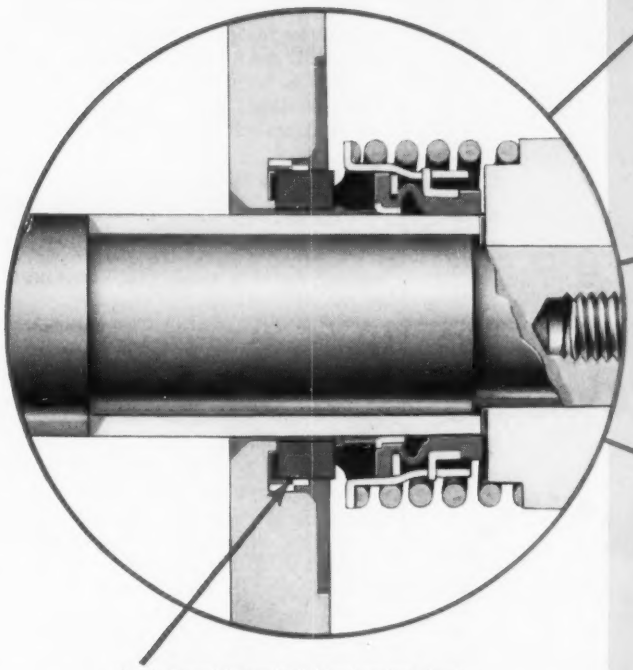


B & G Series 1510-B
Capacities to 1100 GPM,
heads to 420 ft.



B & G Series 1531-B
Capacities to 1500 GPM,
heads to 420 ft.

B & G Series 1522
Capacities to 150 GPM
heads to 115 ft.



Leak-Proof "Remite" Mechanical Seal

This exclusive B & G feature eliminates the customary leakage which occurs where a packing gland is used. A Carbon Seal Ring faces on a "Remite" floating seat—*a new type of material, so hard it will scratch glass—wear-proof and corrosion-resistant.* Metal parts are of steel, bronze or stainless steel, depending upon the type of service. The B & G Mechanical Seal is self-lubricating.

Take just a moment to examine the design features of B & G Centrifugal Pumps. You'll find plenty of reasons why these pumps are giving trouble-proof performance through long years of service.

Vertical split-case construction permits removal of the bearing bracket without disconnecting pipe lines or motor leads. Solid cast iron volutes—with support feet in the larger units—effectively prevent transmission of piping strains to the motor.

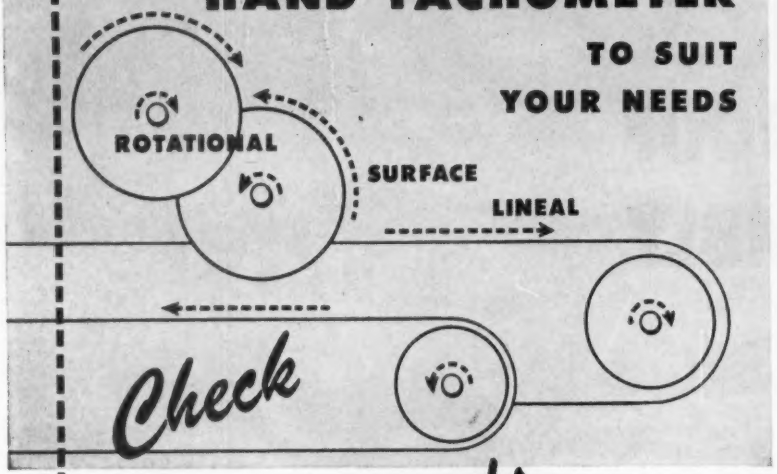
The shafts of B & G Centrifugal Pumps are an outstanding feature. Made of special alloy steel, they are super-finished and oversized to keep deflection at a minimum. The "Remite" Mechanical Seal— a B & G development—positively prevents leakage...and impellers are soundly designed to maintain hydraulic balance. An oil lubrication system, instead of grease cups, assures continuous protection to the long bronze bearings of these pumps.

B & G Centrifugal Pumps are available as all-iron, bronze-fitted, all-bronze and stainless steel units and in capacities which adapt them to a wide range of industrial applications.

Send for complete data on these three outstanding centrifugal pumps

BELL & GOSSETT
COMPANY
Dept. ET-36, Morton Grove, Illinois
Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Drive, W. Toronto

THERE'S A BIDDLE HAND TACHOMETER TO SUIT YOUR NEEDS



SLIPPAGE
STRESSES
LOAD
LUBRICATION
FRICTION
POWER TRANSMISSION
ETC.

Speeds

Accurately

JAGABI® TACHOMETER
Speeds Up to 48,000 RPM
Single or Multiple Ranges

DR. HORN TACHOMETER
25 to 30,000 RPM—6 ranges

JAGABI® SPEED INDICATOR
Speeds Up to 100,000 RPM

JAGABI® TACHOSCOPE
A Speed Counter and Stop Watch in one

FRAHM®

RESONANT REED TACHOMETER. No contact with moving parts—just touch to case of machine or motor housing—read directly in rpm.

Write For "Biddle Speed Instruments"—BULLETIN 35 – P

JAMES G. BIDDLE CO.
Electrical & Scientific Instruments
1316 ARCH STREET, PHILADELPHIA 7, PA.

B-701

Marmy's Mailbox

'Tis here you exchange blasts with the old boy

CRACKING UP?

East is east and west is west and never the twain shall meet. In Marmy's *Lost Revolutions,* I believe the old boy is cracking up. Chile and Peru are not on the Eastern Coast of South America.

I never though I'd be smart enough to find an error in his wonderful stories. Frankly, it doesn't make any difference which coast he sailed on for the story is still excellent.

J W SEGRAVES *Philadelphia, Pa.*

THE BOSS WAS WRONG

I'm glad an old-timer like Marmy is around to keep younger engineers in touch with the old days. His stories remind me of a tough job I had as chief.

The owner was always raising hell with the hand-firing firemen. About 40 were hired and quit during the first two years. Then one day he said he'd hire firemen personally.

Next morning the boss' new fireman had only 40 lb steam, instead of 160 when it came time to start up. And, before the day was over, the boss had hired eight different men—but we still didn't have enough steam to start the plant.

That night he admitted he made a mistake. He told me that I should hire the firemen. That fireroom was hot, and the fireman had to know his stuff. It wouldn't hurt some of our modern armchair engineers to have some of that experience. Hope Marmy keeps sounding off.

A L SHEA *Jamaica, N. Y.*

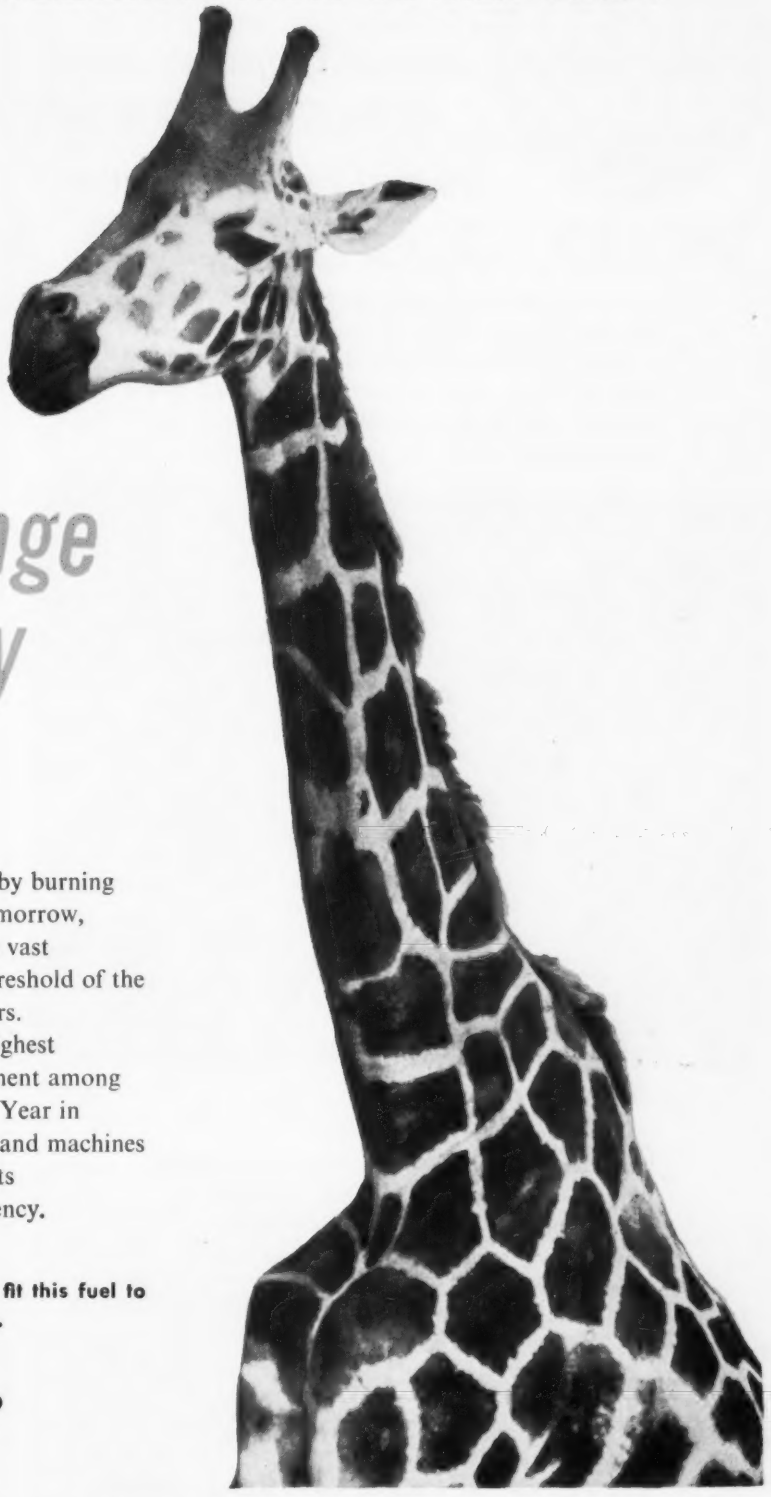
RUBE AND SLICKER

Buried Treasure, March 56, is excellent. I enjoyed it thoroughly. Reminds me of some solutions which Edison had for solving what seemed difficult problems. He'd ask young assistants fresh from college to figure the cubic area of a light bulb's inside. They'd work on it for days—keep coming up with different answers. Edison took the light bulb, put a hole in it, filled it with water and poured the water into a container of a more regular shape.

This kind of story is entertaining, a little challenging and it's always fun to see the rube outsmart the city slicker.

H CAREY *New York, N. Y.*

UNCERTAIN OPERATING COSTS BOTHER YOU?



depend on the only

long range economy fuel

You'll win in the long run by burning Bituminous! Today and tomorrow, supply is unlimited and the vast reserves are right on the threshold of the major manufacturing centers. Bituminous, too, has the highest potential for cost improvement among competing industrial fuels. Year in and year out new methods and machines are designed to control costs and improve burning efficiency.

Let B&O's Technical Service fit this fuel to your long range power plans.
Ask our man!

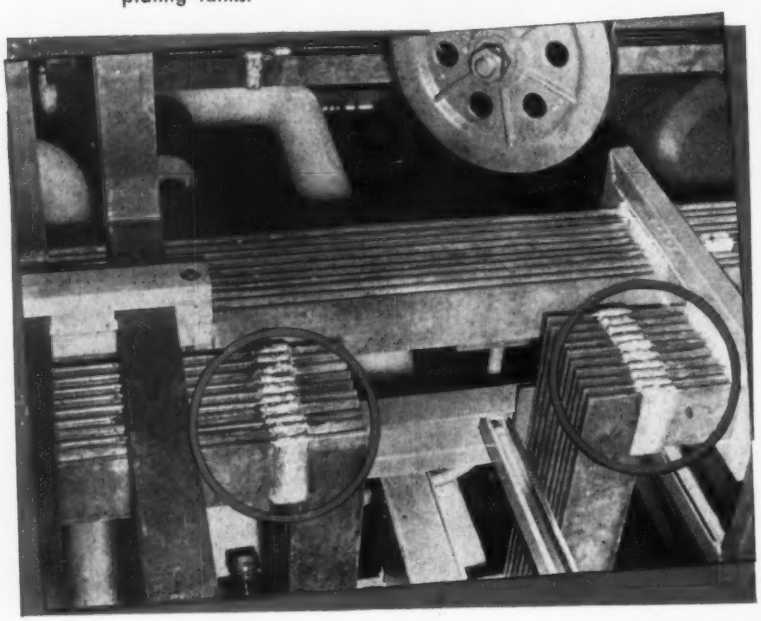
COAL TRAFFIC DEPARTMENT
BALTIMORE & OHIO RAILROAD
Baltimore 1, Maryland
Phone: LExington 9-0400

BALTIMORE & OHIO RAILROAD
BITUMINOUS COALS FOR EVERY PURPOSE

GENERAL ELECTRIC

endorses Contractor's use of CADWELD® electrical bus bar connections

HATFIELD ELECTRIC CO., INC., nationally-known electrical contractor recently completed an electrical bus bar installation for the GENERAL ELECTRIC COMPANY at Louisville, Kentucky. CADWELD ELECTRICAL CONNECTIONS were used on the ½ x 3 and ¼ x 4 bus bars that feed the GENERAL ELECTRIC plating tanks.



HATFIELD and GENERAL ELECTRIC were completely satisfied with their first experience with CADWELD on a multiple bus installation. Both companies have been using CADWELD for grounding connections for over five years.

Before figuring your next bus installation, investigate **CADWELD.**

CADWELD®

Erico Products, Inc.

2070 E. 61st Place Cleveland 3, Ohio

IN CANADA: ERICO INCORPORATED, 3571 Dundas St., West, Toronto 9, Ontario

More TECHNICAL BRIEFS

Begins on page 156

Nuclear power

The technical problems of designing and operating reactors for producing electrical power and the problems of making them economic. *By H H Gott, UK Atomic Energy Authority.*

This paper reviews the various types of reactor that are potentially available for power production. It emphasizes that this is already a large scale industrial and economic problem, and types of plant which do not have the backing of extensive allied engineering experience are at a disadvantage. In a fully developed power system involving a large number of units the author wishes to see parallel operation of gas-cooled thermal reactors and sodium-cooled fast reactors.

The gas-cooled reactor produces electricity competitively without need for enriched uranium fuel or any other isotope separation plant. Moreover, it is inherently safe, perhaps the only reactor whose safety can be relied on under any foreseeable circumstances. The high concentration of fissile material in the fast reactor implies a need for a very high heat release. This may be difficult to achieve for a core with a very high gain factor, so a compromise must be expected. *WPC paper No. 175J12.*

Status report on the pressurized water reactor (PWR) plant. *By J W Simpson.*

The Shippingport power plant is sponsored by the United States Atomic Energy Commission to further the peacetime use of atomic energy in electric power generation. The design, construction and operation of this full scale nuclear power plant will provide much knowledge in reactor physics, fuel element and core technology, and component and system design. By actually designing, manufacturing, operating and maintaining the full-scale components required for such a power plant, future plants of a similar type can be developed and evaluated with greater accuracy. The plant organization will serve as a pattern for establishing operation forces for nuclear power stations, and the facility will also provide training for personnel for future plants. *WPC paper No. 172J10.*

A 180 megawatt boiling water reactor power plant. *By T G Leclair, Commonwealth Edison Co.*

The principal design features of the 180,000-kw electrical output dual-cycle

Directions for ordering papers on page 210

ILLCO-WAY

ILLINOIS WATER TREATMENT CO.

ionXchange *Announces...*

COUNTERFLOW*

A NEW METHOD OF ION-EXCHANGE THAT PRODUCES BETTER QUALITY EFFLUENT AT LOWER COST

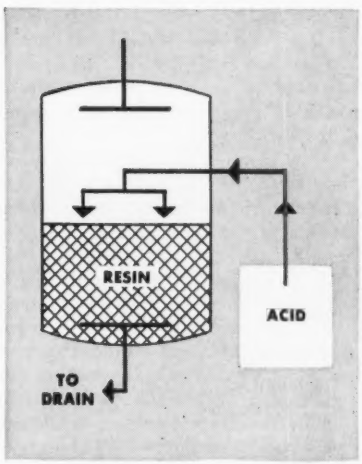


FIG. 1 CONVENTIONAL REGENERATION

It has been recognized that breakthrough of ions, chiefly sodium, occurs in conventional ion-exchangers, causing a contamination of the effluent. This is due to layered retention of some metallic ions in the resin bed during normal operation. Studies show that these layers consist of Ca^{++} ions near the upper part, Mg^{++} ions in the middle, and Na^{+} ions through the lower part of the resin bed. Conventional regeneration does not completely remove the bottom layer of sodium ions. When back on service, these sodium ions are then kicked out and appear as contaminants of the effluent.

Many efforts have been made to overcome this undesirable situation, with limited success. *Now, at last, Illinois Water Treatment Company has discovered and developed a corrective method which has been thoroughly tested and has proved consistently and fully effective.*

The conventional method of regeneration is shown diagrammatically in Fig. 1. One form of the new ILLCO-WAY method is shown in Fig. 2. The principal feature of the new ILLCO-WAY method is the upward passage of the regenerant, combined with some form of barrier to keep the resin bed from expanding. Previous attempts at upward regeneration failed because the low-density resin materials now commonly employed have a tendency to expand and channel. The result was a very inefficient regeneration. Increased concentrations of the regenerant only added to costs without significantly improving the results.

Actual installation experience with the new ILLCO-WAY method shows an almost complete elimination of sodium contamination uniformly throughout each run. Fig. 2 illustrates one type of barrier that may be employed, namely, a downward pressure of water which keeps the resin bed from expanding. The mixture of water and regenerant is drawn off by a distributor located near the resin face.

If the purity of the effluent from your de-ionization equipment is not satisfactory, we suggest you discuss immediately, with your Illinois Water Treatment representative, this new and effective method of correcting it.

REPORT FROM A TYPICAL INSTALLATION

An existing conventional two-bed ion-exchange installation in Nebraska was converted to the new method described above. A study of results and operating costs over a six-month period shows a substantial improvement in the purity of the effluent (from a conductance of 25-5 micromhos to 6-0.5 micromhos) and a great reduction in cost of regenerants (from 7.34c per 1000 lbs. of effluent to 3.51c).

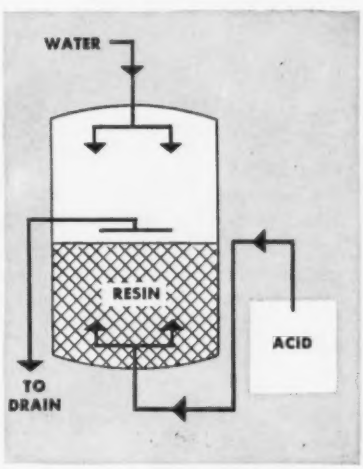


FIG. 2 COUNTERFLOW REGENERATION

* "COUNTERFLOW" is the trademark of Illinois Water Treatment Company equipment utilizing a distinctly new principle of regeneration. Patent pending.

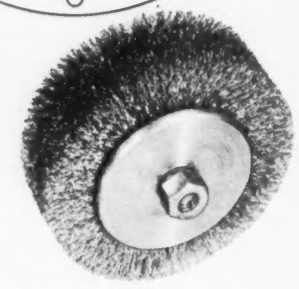
ILLINOIS WATER TREATMENT CO.

840 CEDAR STREET, ROCKFORD, ILLINOIS

ROTOJET®
Tube Cleaners

Clean tubes and pipes from ½" to 12" I.D. THOROUGHLY QUICKLY

ROTOJET Model 512 Air-driven Motor, universal joint, swing-frame head, and solid brush.



Our large stock of Rotojet air-driven and water-driven tube cleaners, accessories, and repair parts for straight and curved tubes, pipes, and transfer lines is available to meet most requirements without delay. Tube cleaner specialization for 43 years assures satisfactory results from any Rotojet equipment we recommend. Send for Bulletins J-410 and R-105. For quick action wire or phone, HUmboldt 3-0570.

ROTOJET Model C-525 Air-driven Motor with swing-frame head and universal joint.

ROTOJET Junior Model S32 Air-driven Motor, universal joint, cone cutter.

ROTOJET Junior Model C434 Air-driven Motor, flexible coupling, expanding brush.

ROTOJET Model C-526 Air-driven Motor with pivot head and universal joint.

ELLIOTT COMPANY - ROTO DIVISION

Tube Cleaner Specialists Since 1910

153 Sussex Avenue, Newark, N. J.

More TECHNICAL BRIEFS

Begins on page 156

boiling reactor are the heterogeneous, slightly enriched fuel elements, and light water heat transfer agent and moderator. The plant will be constructed in northern Illinois and will be owned and operated by Commonwealth Edison Co.

It is the largest all-nuclear plant yet proposed and will be financed entirely by private funds. The cost will be $45,000,000, or $250 per kw, plus the cost of land and overhead. This type of plant has distinct possibilities as an economic future source of electric energy. In certain high-fuel-cost areas of the world, it is believed to be competitive now. The companies involved in this venture believe that construction and operation of this plant will make a substantial contribution to the art of power generation and to the more efficient use of available energy sources. *WPC paper No. 171J9.*

Considerations involved in a first nuclear-electric power reactor in New England. *By R L Fitzgerald, New England Electric System.*

Objectives sought by undertaking a nuclear power project in New England at this time are: (1) practical experience in operation and maintenance of a nuclear power plant (2) working out solutions to problems such as public liability insurance coverage, regulatory requirements, employee and public relations (3) development of efficient operating procedures for an integrated nuclear, hydro and conventional steam power supply system (4) stimulation to the development of the nucleonics industry in New England.

Fuel cost in New England is high, relative to the low United States average. This accentuates interest in a potentially cheaper energy source. The best choice of reactor type for reliability, reasonable efficiency and adaptability to future developments at this time appears to be the pressurized light water - cooled - and - moderated design which has already proven its technical feasibility in the submarine *Nautilus. WPC paper No. 173J11.*

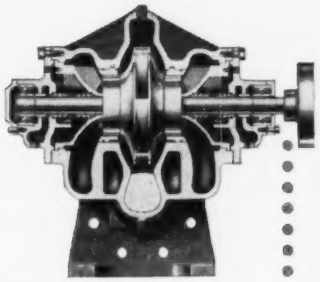
Economics of nuclear power. *By U M Staebler, U.S. Atomic Energy Comm.*

There can be little doubt that nuclear power plants will become an important part of the world's power system of the future. Increasing energy demands and decreasing supplies of conventional energy sources will necessitate increasing use of this new source of energy.

(*Continued on page* 200)

Directions for ordering papers on page 210

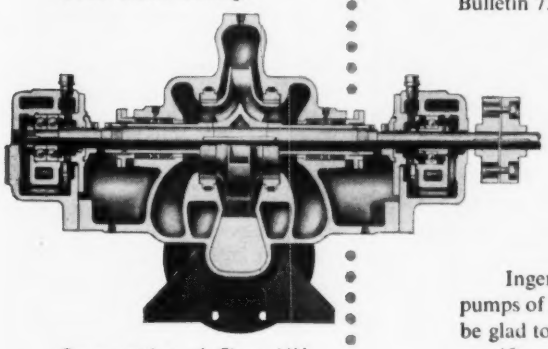
for *DEPENDABILITY* plus *ECONOMY*
...IN GENERAL PUMPING SERVICE



Cross section of Maintenance-Free class DMV and DHV pump with double mechanical shaft seals and prelubricated sealed bearings.

I-R Single-Stage, Horizontally-Split Centrifugal Pumps offer many features for trouble-free performance and low operating and maintenance costs

For capacities from 250 to 2400 gpm and heads to 350 ft., the DMV and DHV Pumps shown at the left provide important savings in floor space and virtual immunity to stuffing-box and lubrication problems. All units are equipped with double mechanical shaft seals that eliminate stuffing-box maintenance and pre-lubricated sealed ball bearings that require no attention or lubrication for the life of the pump. For complete details, send for Bulletin 7248-A.

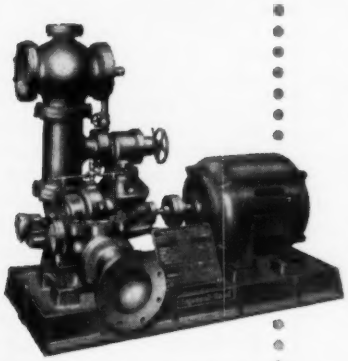


Cross section of Class ALV single-stage pump with conventional stuffing-boxes and shaft bearings.

The standard line of I-R single-stage, horizontally-split pumps, of which the Class ALV unit illustrated is typical, covers the broad operating range from 25 to 50,000 gpm and heads from 20 to 350 ft. Extra-deep stuffing-boxes are equipped with seal cages for the supply of sealing liquid from pump discharge passage or an external source. Two-piece split glands are easy to remove and replace for repacking the box. All of these pumps can be provided with any desired type of drive.

Ingersoll-Rand also offers a complete line of single- and multi-stage pumps of both the horizontal and vertical type. Your I-R representative will be glad to give you complete information on the pumps best suited to your specific requirements.

...IN FIRE PUMP SERVICE



External view of a 5FUV Fire Pump equipped with grease-lubricated ball bearings and *fire fittings.*

I-R Fire Pumps have been completely approved by the National Board of Fire Underwriters and the Associated Factory Mutual Fire Insurance Companies

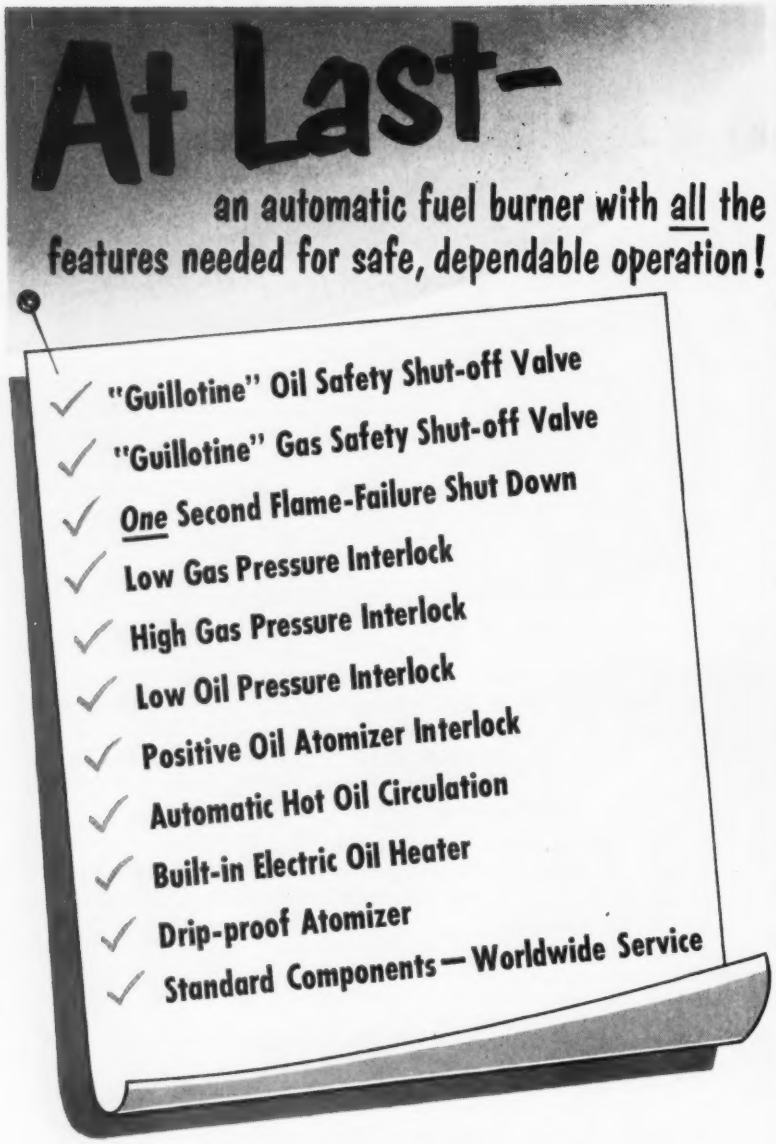
Except for details of pump fittings, I-R Horizontal Fire Pumps are identical to the general-purpose units shown above. Fully approved for permanent installations of the hose line or sprinkler type, they provide dependable fire protection for public buildings, small cities, factories, shipyards, hotels and mines.

I-R Horizontal Fire Pumps are available, with any desired standard fire fittings, in capacities of 750 and 1000 gpm at 100 and 125 psi, or 1500 and 2000 gpm at 100 psi. Vertical Units are also available for 750 and 1000 gpm at 100, 125 and 150 psi. Send for Bulletin 7226.

Ingersoll-Rand

10-453 11 BROADWAY, NEW YORK 4, N. Y.

PUMPS • CONDENSERS • COMPRESSORS • DIESEL ENGINES • AIR AND ELECTRIC TOOLS • VACUUM EQUIPMENT


At Last—
an automatic fuel burner with all the features needed for safe, dependable operation!
"Guillotine" Oil Safety Shut-off Valve
"Guillotine" Gas Safety Shut-off Valve
One Second Flame-Failure Shut Down
Low Gas Pressure Interlock
High Gas Pressure Interlock
Low Oil Pressure Interlock
Positive Oil Atomizer Interlock
Automatic Hot Oil Circulation
Built-in Electric Oil Heater
Drip-proof Atomizer
Standard Components—Worldwide Service

Peabody's PK-54 Burner—*and only the* PK-54 *Burner* has *all* these "premium-safety" and operating features... that's why the PK-54 is "first-choice" of the nation's leading boiler manufacturers and experienced, progressive Consulting Engineers.

Designed around a simple, basic concept, the PK-54 offers a high degree of flexibility. It will accommodate: all standard liquid or gaseous fuels • semi or fully automatic operation • positioning or metering combustion controls • electric or pneumatic systems • all standard electrical supply voltages.

Your *BEST BUY* in an industrial automatic burner!

PEABODY ENGINEERING CORPORATION

232 MADISON AVENUE, NEW YORK 16, N. Y.

OFFICES IN PRINCIPAL CITIES

PEABODY LIMITED • LONDON, S.W. 1, ENGLAND

7-056

More TECHNICAL BRIEFS

Begins on page 156

Requirements for power reactors will vary, depending upon regional differences. It is unlikely, therefore, that a single reactor concept will emerge as the best for all civilian power production. Rather, a variety of types can be expected to find practical application.

Unfortunately, very little factual information is available on the economics of nuclear power. Under some conditions, nuclear power costs of seven mills per kwhr or less might be achieved in the United States from plants with 100,000 kw or more generating capability. Achieving low cost nuclear power depends upon solving many technical factors affecting the cost of power production. *WPC paper No. 170J8.*

Status of nuclear power technology. *By W K Davis, U.S. Atomic Energy Commission.*

Economic nuclear power is not yet here except, perhaps, for very special circumstances, but it does seem quite possible and feasible even in the United States where we have large resources of conventional fuels—but fuels which perhaps can be conserved for more important uses.

Sufficient knowledge has been gained to proceed with the design, construction and operation of several different types of reactor systems. Major advancements in technology will be required, however, before competitive costs can be achieved. Several years will be required for achieving even the early goals both because of the technical difficulties and because of the time required for the first plants to be built and operated. *WPC paper No. 169J7.*

Atomic fuels. *By F H Spedding, Iowa State College.*

A number of basic factors that determine the type of fuel elements or assemblies which would be used in an economical power reactor are discussed. Particular emphasis is placed on factors that markedly influence the reactor design, the desirable fuel cycle to be used, and net cost of producing power from such reactors. *WPC paper No. 129J5.*

Atomic energy progress in Sweden 1945-1955. *By H Brynielsson, Swedish Atomic Energy Co.*

Sweden has no coal or oil deposits worth mentioning but in her alum shale deposits she has an abundant but low-grade raw material for uranium. Atomic energy therefore must be of great inter-

(*Continued on page* 204)

Directions for ordering papers on page 210

TESTING—1, 2, 3

This New Foster Wheeler
COOLING TOWER TEST CENTER
is your assurance of
higher cooling efficiency and long tower life

OVER 40 years of experience notwithstanding, *research* continues to play an important part in Foster Wheeler cooling tower work. Latest addition to FW cooling tower research facilities, is the fully equipped test center shown above. Here every detail of design is subjected to exhaustive and precisely measurable tests under conditions identical to those encountered in actual service. In addition to proving the superior thermal and mechanical design of FW Cooling Towers, this research is continually helping to develop new and improved construction methods and materials, for higher performance standards and longer cooling tower life.

For complete information on the new line of Foster Wheeler Induced-Draft, Counter-Flow Cooling Towers, send for Bulletin No. *CT-56-11. Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.*

1 Large Commercial Size Cooling Tower, 30′ by 30′ ground area and 44′ height, with removable casing panels for testing of various materials. Includes provision for measuring temperatures, pressures, water and air flow throughout the tower, with the ability to vary these conditions over a wide operating range.

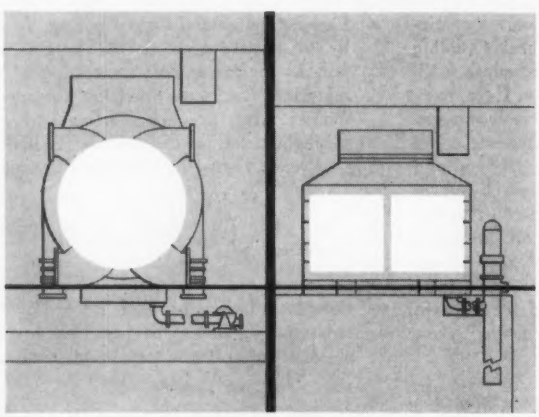
2 Small-scale Pilot Tower for preliminary exploration.

3 Complete Indicating and Recording Instrumentation facilities for precise measurement of all tower test and psychrometric data.

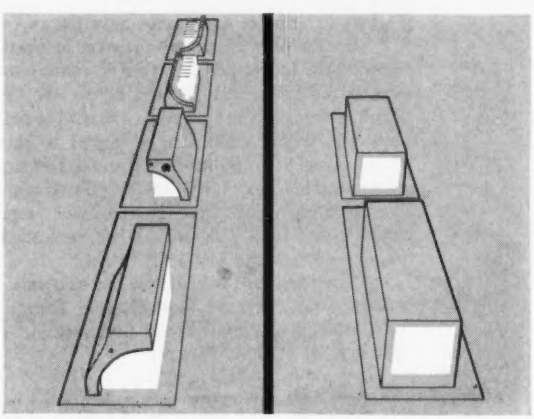
FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

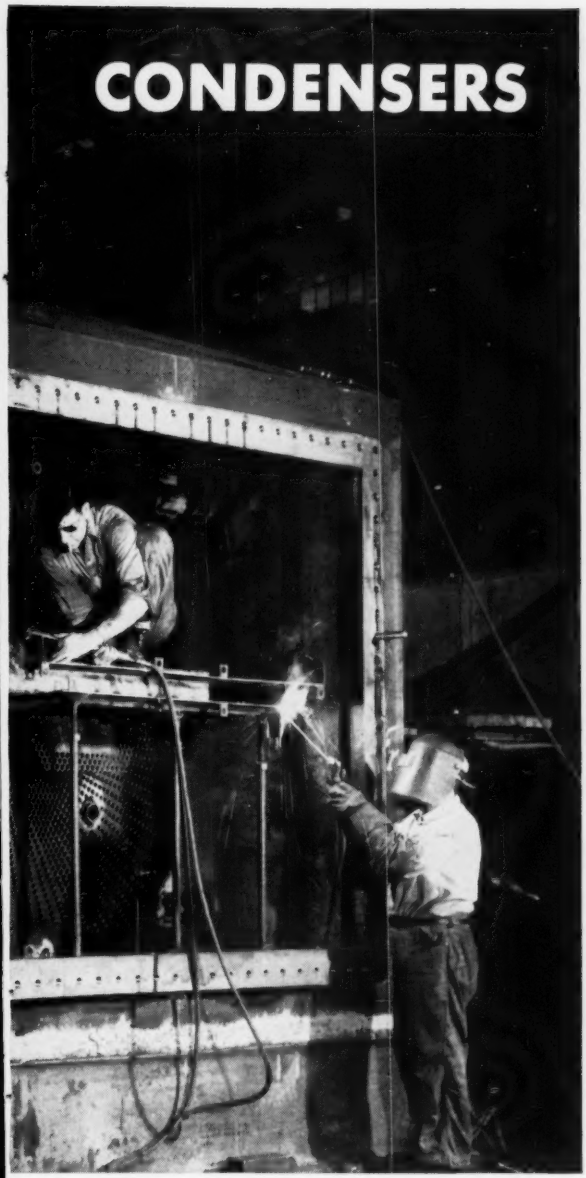
WESTINGHOUSE RECTANGULAR



Waste no space! Rectangular condensers require less headroom, fully utilize all space under turbine.



Faster installation! Rectangular condensers can be shipped in "bigger chunks" . . . less field welding.



...another great timesaver for station erection schedules

SAVE TIME—Basic simplicity of rectangular condenser design makes it possible to ship "bigger chunks of capacity." Building-block assembly speeds rigging; field welding is drastically cut. With its flat base, it is quickly and easily leveled. Westinghouse rectangular condensers can get you on the line faster.

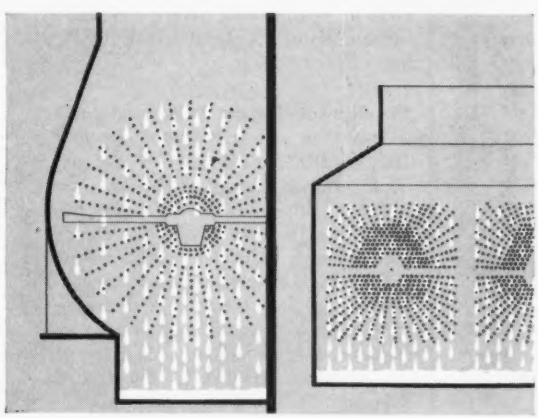
SAVE SPACE—As station ratings go higher and higher, equipment gets bigger. That's when space utilization takes on increasing importance. Westinghouse rectangular condenser design uses *all* the space under the turbine—*wastes none.*

BOOST EFFICIENCY—Two things, above all, you want from a condenser: Lowest possible absolute pressure, maximum reheating and deaeration of condensate. With its two-compartment radial-flow design and consequent short steam path to center air offtakes, a rectangular condenser provides lowest pressure drop. Uniform fall of condensate and the counterflow of steam from the lower steam belt liberate oxygen and assure deaerated condensate at saturation temperature.

Get the full story on Westinghouse condensers, circulating pumps, condensate pumps and air ejectors from your Westinghouse representative; or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-50595

YOU CAN BE SURE...IF IT'S

Westinghouse



Boost efficiency! Lowest pressure with maximum reheat; condensate falls uniformly through belt of steam.

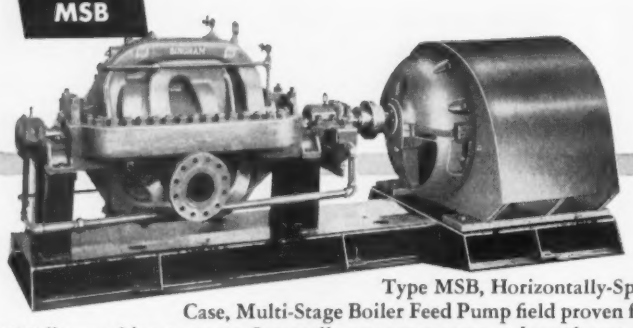
Specify

Bingham

"DOUBLE VOLUTE"
BOILER FEED PUMPS

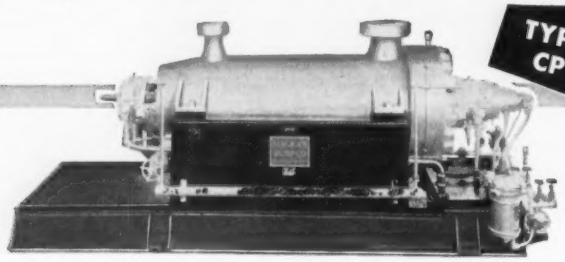
for the ultimate in dependability
IN HIGH PRESSURE SERVICE

TYPE MSB



Type MSB, Horizontally-Split Case, Multi-Stage Boiler Feed Pump field proven for 1200 lbs. working pressure. Integrally cast cross-overs and evenly spaced case bolting located uniformly close to the shaft center line, enclosing a minimum pressure area, eliminate case distortion and inter-stage jetting.

TYPE CP



Type CP, Multi-Stage, Double-Case Boiler Feed Pump with forged outer barrel for high pressure service.

All BINGHAM Boiler Feed Pumps feature: (1) "Double Volute" construction, resulting in full radial balance of the rotating element *throughout the entire operating range of the pump.* (2) Double suction first stage for low NPSH. (3) Balanced axial thrust (no balancing drums needed). (4) Kingsbury Thrust Bearings. (5) Stuffingboxes subjected to suction pressure only. (6) Design for High Speeds.

Bingham SINCE 1921

DOUBLE VOLUTE PUMPS RADIAL BALANCE

BINGHAM PUMP COMPANY
General Offices: 2800 N. W. Front Ave., Portland 10, Oregon
Factories: Portland, Ore. • Vancouver, B. C., Canada

SALES AND SERVICE OFFICES

Boston, Mass. — New York City, N. Y.
Chicago, Ill. — Philadelphia, Pa.
Cleveland, Ohio — Pittsburgh, Pa.
Dallas, Texas — San Francisco, Calif.
Denver, Colo. — Seattle, Wash.
Houston, Texas — St. Louis, Mo.
Kansas City, Mo. — St. Paul, Minn.
Los Angeles, Calif. — Tulsa, Okla.
New Orleans, La. — Toronto, Ont., Can.
Vancouver, B. C., Canada

More TECHNICAL BRIEFS

Begins on page 156

est for the future energy supply of the country.

Atomic energy work is divided between two organizations, the Atomic Energy Commission and the Atomic Energy Company.

In July, 1954, the Company started the first Swedish experimental reactor R 1 in an underground laboratory in Stockholm. This reactor provides information about the running of reactors and the arrangements for regulation, control and measurement, protection against radiation, etc.

As the next step there are plans to build a development reactor with the highest possible neutron flux and with facilities for carrying out experiments at high temperatures. For this reactor and future experimental work in the reactor field, the Company has acquired an area of about 300 acres at Studsvik, about 80 kilometres south of Stockholm. *WPC paper No. 128J4.*

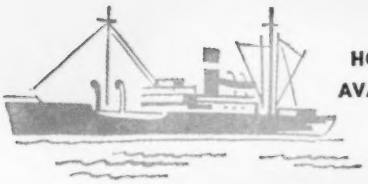
Disposal of atomic wastes in the atomic energy industry. *By A E Gorman, U.S. Atomic Energy Commission, and G E McCallum, U.S. Public Health Service.*

While the power industry is making extensive plans for world wide use of atomic energy, it must also evaluate the environmental problems associated with release of radioactive and toxic wastes from this new industry. Important considerations are careful selection of sites for nuclear reactors and chemical plants for processing fuel elements. United States experience in resolving these problems has called for co-operation at high technical levels by many professions. Furthermore, it has indicated that site selection and waste disposal are important considerations in planning plant facilities and obtaining approval of public health and safety officials in locating new plants, especially in the more populated areas. *WPC paper No. 130J6.*

The disposal of waste waters and gases in a nuclear power program. *By H J Dunster, D R R Fair, and A S McLean, U. K. Atomic Energy Authority.*

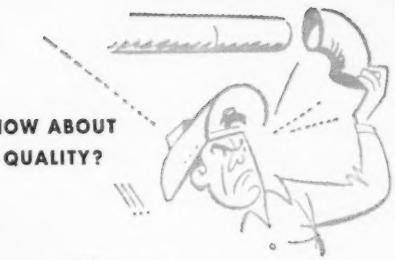
The principal sources of radioactive wastes are reviewed and their relative importance is indicated. Both reactors and chemical processing plants are considered. Typical methods of disposing of these wastes are outlined and, as an example, a brief indication is given of the practices adopted in the United Kingdom. It is concluded that the tech-

Directions for ordering papers on page 210



HOW ABOUT AVAILABILITY?

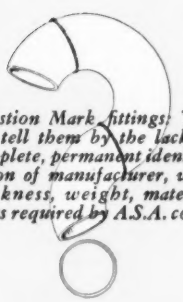
HOW ABOUT QUALITY?



HOW ABOUT IDENTIFICATION?

HOW ABOUT YOUR REPUTATION?

Why try to cut corners with *Question-Mark** fittings?



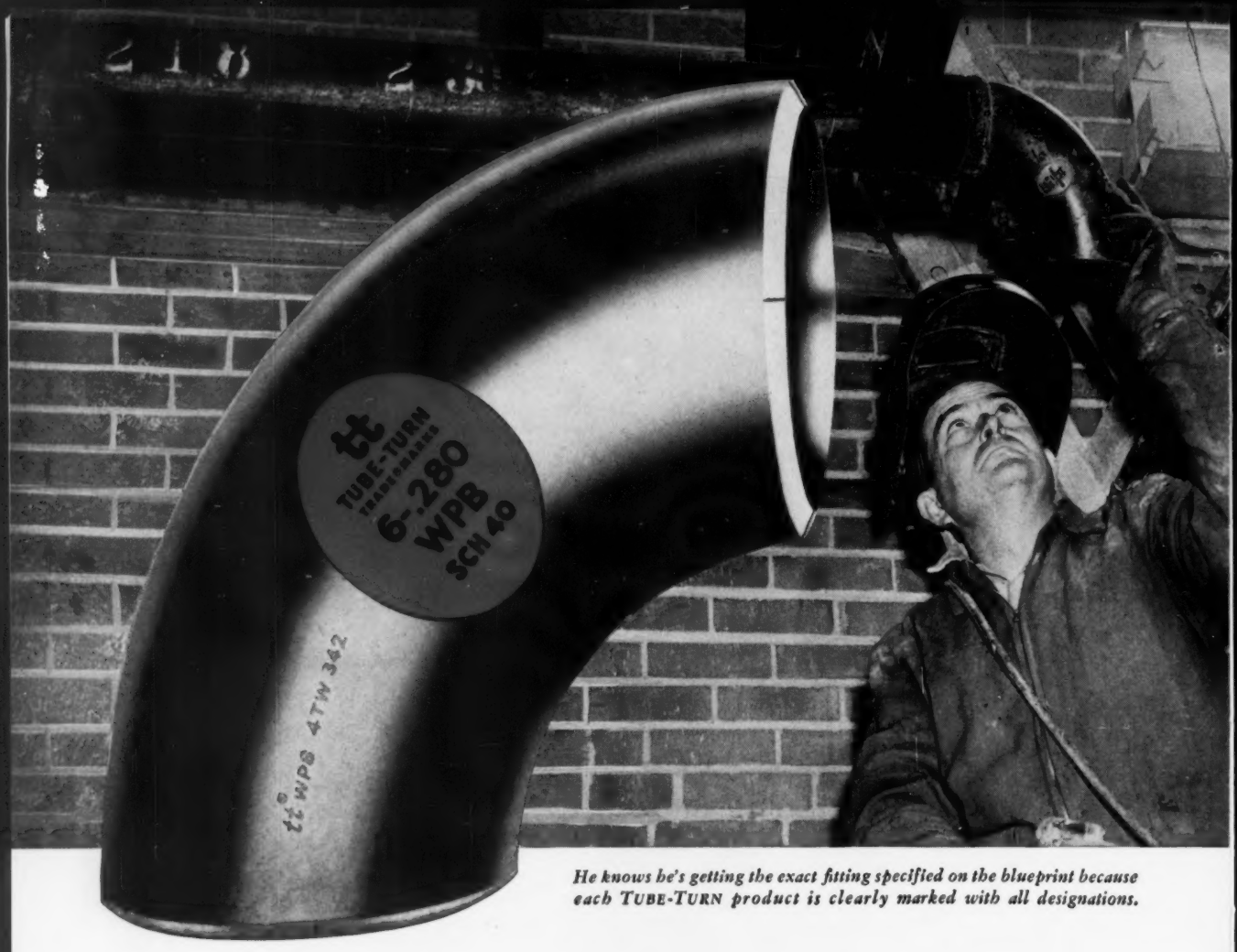
**Question Mark fittings: You can tell them by the lack of complete, permanent identification of manufacturer, wall thickness, weight, material ... as required by A.S.A. code.*

Unknown welding fittings are as risky as unmarked turns on a busy highway. These blind spots in an expensive piping project cause slow-downs, confusion, trouble . . . waste time and money.

"Question Mark" fittings may look like a bargain on the price tag, but watch out for the after-costs . . . poor fit-up, impaired quality, questionable supply, lack of engineering service! Your reputation is at stake!

A message in the interests of top quality piping . . .
by Tube Turns, Louisville, Kentucky.

HOW TO SAFEGUARD YOUR REPUTATION



He knows he's getting the exact fitting specified on the blueprint because each TUBE-TURN product is clearly marked with all designations.

Save manhours...avoid piping risks with known fittings

You save purchasing time, get prompt delivery, speed up installation, and help assure reliable piping performance when you specify TUBE-TURN* Welding Fittings and Flanges. They meet all American Standard and Safety Code requirements. Each product is permanently marked with complete size and material designation. Your nearby Tube Turns' distributor gives you prompt delivery from the complete-line stock, and makes available Tube Turns' unmatched engineering service.

You *know* your piping investment is safeguarded when you specify and buy Tube Turns' products.

Your nearby Tube Turns' Distributor meets your needs promptly from the complete line of more than 12,000 Tube Turns' stocked items.

The Leading Manufacturer of Welding Fittings and Flanges

TUBE TURNS

LOUISVILLE 1, KENTUCKY

A Division of National Cylinder Gas Company

DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Chicago • Detroit • Atlanta • New Orleans • Houston • Midland
Dallas • Tulsa • Kansas City • Denver • Los Angeles • San Francisco • Seattle

In Canada: Tube Turns of Canada, Ltd., Ridgetown, Ontario • Toronto, Ontario • Edmonton, Alberta

*"TUBE-TURN" and "tt" Reg. U. S. Pat. Off.

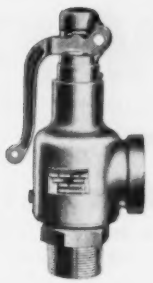
POSITIVE PROTECTION
AT ANY PRESSURE...
specify Consolidated

Get protection you can be sure of — whatever your working pressure. Specify Consolidated Safety Valves. Thousands of installations, in both large and small steam generating plants, attest to their complete reliability under all types of service conditions.

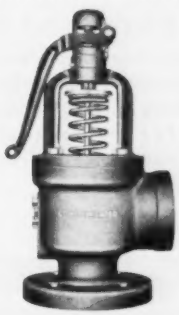
Many Consolidated Valves, with bronze body, are widely used for steam, air and water service; many more are installed in power plants as auxiliaries to Consolidated Steel Safety Valves. The cast iron and steel types are proving their dependability daily on low pressure boilers and those operated at super-critical pressures. The five different Consolidated Valves pictured here are representative types but the line is so complete, proper selection is no problem.

Consolidated Safety Valves are ruggedly built for long service life. Each type incorporates the fewest possible working parts for greatest efficiency. Precision craftsmanship assures positive, tight closing after operation. Through skillful engineering, valve adjustment and maintenance are made simple and easy. All these essentials contribute to outstanding performance, safety and economy.

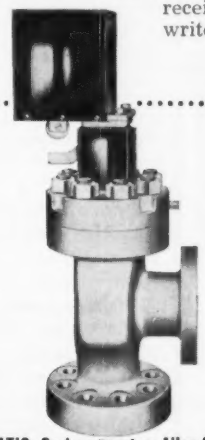
Just send us details of your particular service requirements and you will receive correct valve recommendations. Or write for Catalog 700A.



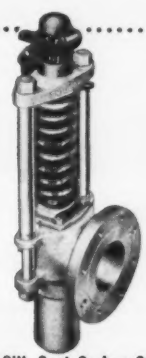
TYPE 1551. Cast Bronze Body. For package-type and fire tube boilers, air tanks and other classes of unfired pressure vessels. **Sizes:** ⅜" through 3". **Pressures:** up to 300 psi. **Temperatures:** up to 450° F.



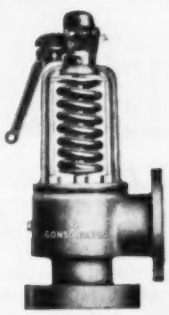
TYPE 1511. Cast Iron Body. An all-purpose safety valve for steam generator service. Cuts cost per pound of steam discharged. **Sizes:** 1½" through 6". **Pressures:** up to 250 psi. **Temperatures:** up to 450° F.



ELECTROMATIC. Carbon Steel or Alloy Steel. An electrically actuated relief valve for boiler service. Operable automatically, manually or cut out of service by setting remote control switch. Supplements spring-loaded safety valves — conserves power and increases efficiency of steam generating plants. **Sizes:** 2½" through 14". **Pressures:** up to 2500 psi. **Temperatures:** up to 1100° F.



MAXIFLOW. Cast Carbon Steel or Cast Alloy Steel. A safety valve with the greater discharge capacity and shorter blowdown demanded by high pressure, high temperature steam generators. **Sizes:** 1½" through 4". **Pressures:** up to 2500 psi. **Temperatures:** up to 1050° F.



TYPE 1415. Cast Steel Body. For water tube boilers, mechanically fired fire tube boilers, accumulators, unfired pressure vessels and pipelines. **Sizes:** ½" through 6". **Pressures:** up to 900 psi. **Temperatures:** up to 900° F.

In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario.

CONSOLIDATED SAFETY VALVES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONN.

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'ASHCROFT' GAUGES, CONSOLIDATED SAFETY VALVES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, *Stratford, Conn.* 'HANCOCK' VALVES, *Watertown, Mass.* 'CONSOLIDATED' SAFETY RELIEF VALVES, *Tulsa, Okla.* AIRCRAFT CONTROL PRODUCTS, *Danbury & Stratford, Conn. and Inglewood, Calif.* "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Mich.*

WIEDEKE

THE QUALITY NAME IN TUBE EXPANDERS . . . SINCE 1892

SERIES 255

Tube Expanders — For Heat Transfer Units.

Made in Tube sizes ¼" through 1½" and with Rolls up to 2¼" long.

IDEAL

SERIES 270

Tube Expanders—Now standard for tube sheets up to 6" thick.

Longer reaches available for heavier sheets.

Write for New Bulletin "C"

(35)

The Gustav WIEDEKE Company

Dayton 1, Ohio

FRICK

Refrigeration Serves Big Armour Laboratories

Armour and Co. use "cold" in many ways in their great Pharmaceutical Laboratories, recently opened near Kankakee, Ill. These uses include air conditioning, biological process work, cold storage, heat-pump service, and research.

Temperatures can be held anywhere between −45 and +45 degrees F., but usually go no lower than −10.

Here a 2-stage Frick system of 1422 tons refrigerating capacity operates with efficiency and economy. Installation by Midwest Engineering and Equipment Co., Frick Sales-Representatives in Chicago.

Four of eight ammonia compressors furnishing refrigeration at temperatures down to −45° F.

For that important refrigerating, air conditioning, ice making or quick freezing job of yours, look to dependable Frick equipment. Sales-engineering and service, the world over. Let us submit estimates now: write, wire or phone

DEPENDABLE REFRIGERATION SINCE 1882

FRICK CO.

WAYNESBORO, PENNA., U. S. A.

More TECHNICAL BRIEFS

Begins on page 156

nical problems of waste disposal are already yielding to investigation and that there is no suggestion that the realization of nuclear power will be delayed on this account. *WPC paper No. 100J3.*

Mechanical engineering features of the Calder Hall nuclear power station. *By R F Bishop, R W Horseman, G W Grossmith, R H Kelsall, K J Cunningham, W R Wooton, A T Bowden, R V Moore.*

This paper gives an account of some mechanical features of the Calder Hall nuclear power station which have been designed and supplied by contractors to the Atomic Energy Authority. An introduction by the project's Chief Engineer reviews the scheme as a whole, and discusses some major items of plant such as pressure vessel, fuel element charge machine, control gear, fuel element monitoring equipment, boiler plant and gas circulating system. Although the complete project is a new one, substantial parts of the engineering work are very closely related to the normal products of their designers and constructors. So the central design team of the Atomic Energy Authority has been able to draw on suitable experience. *WPC paper No. 239J16.*

Nuclear generation and the future power system in Great Britain. *By J C Duckworth, P J Squire, V G Newman.*

Britain is faced with the prospect of a rapidly increasing gap between home production of coal and national energy requirements.

From forecasts of electricity requirements up to 1980 and the proportion which, it is expected, will be supplied from indigenous resources, estimates are derived of the scale of nuclear plant installation that would be needed to make good the deficiency. On this basis, by the end of the period under review, all of the country's base-load would be generated by nuclear plants. However, more than two-thirds of the total plant capacity would still be of conventional type. The scope for pumped storage is examined and the conclusion reached that with progressively increasing nuclear generation the case for its adoption will be considerably enhanced. The siting of nuclear stations is discussed in relation to their technical characteristics and the economic factors relevant to the operational efficiency of the supply system. *WPC paper No. 194J13.*

Directions for ordering papers on page 210

Hall Industrial Water Report

VOLUME 5 APRIL 1957 NUMBER 2

A New Broom Sweeps Water Clean

Coagulant aids are not new, but, just as in the old saying, the newer types of coagulant aids are helping the common coagulants to sweep water freer of suspended matter at lower chemical and operating costs and higher clarifier flow rates. The cleaner water solves problems wherever water is used; in boilers, municipal systems, cooling systems, waste disposal, oil well floods. Hall Laboratories engineers are fully informed on what various aids can do and are ready to help you with your clarification problems.

Flow Rate Doubled With Coagulant Aid

Carryover of floc from large clarifiers in a southern plant was a serious problem because the suspended material adsorbed from the water the glassy phosphate added for control of corrosion in the extensive cooling system.

Water used for cooling purposes was clarified with ferric sulfate and ground calcite. There were no filters, so good clarifier operation was essential. But the floc formed was so fragile and had such poor settling characteristics that the plant operated at one-half capacity part of the time to avoid losing the sludge blanket. During these periods one-half of the cooling water used was not clarified.

Hall Engineers M. C. Scott and V. M. Marcy substituted 6 ppm of a Hagan Coagulant Aid for the calcite. The large, tough floc resulting permitted operation of the clarifiers at full load and with greatly reduced chemical feed.

A water of satisfactory quality is now being produced at a saving of approximately 50 per cent in chemical cost. As a bonus, there are potentially greater savings resulting from the improved water conditions and protection from corrosion.

From Muddy River To Deionized Water

The water used in the electrolytic tinning lines at a Pennsylvania steel mill must be free from suspended material and low in dissolved solids. To make water of such high quality requires complete clarification and deionization.

Until approximately a year ago the first important step of removing suspended matter from the muddy river water was accomplished with aluminum sulfate and lime in clarifiers. The quality of the water going to the deionizers was not all that it should be because the sludge blankets were sensitive to increase in upflow rates and there was trouble with settling of floc.

Hall engineer D. E. Noll recommended the use of a Hagan Coagulant Aid to improve clarifier operation. Results were successful. The sludge blankets stabilized and the floc toughened and settled more rapidly. Time-consuming jar testing previously used for control has been completely eliminated. Feeds of aluminum sulfate and lime were reduced approximately 30 per cent with corresponding reduction in chemical handling and storage space.

An additional saving resulted from reduction in regeneration chemical cost at the deionizing plant. Coagulant aid has surely carved a niche for itself in this plant.

Clarifying Potable Water

A Western Pennsylvania municipal water plant had trouble with floc formation when clarifying with lime and aluminum sulfate. This plant clarifies and filters 15 to 20 mgd of river water in a conventional sedimentation basin. Coagulant aids have eliminated the difficulty. Operating experience showed that both activated silica and a Hagan Coagulant Aid greatly improved floc formation at approximately the same chemical cost. The plant chose Hagan Coagulant Aid because operating cost was reduced by dry-feeding it in comparison with the more time-consuming task of preparing the activated silica sol.

An Aid to Silica Removal

Turbidity in the effluent from the hot-process unit was affecting silica removal at a paper mill in Virginia. Carryover of suspended material became particularly severe on sudden load surges. Often the particles were so finely divided that they passed through the anthracite filters to the paper mill boilers.

The raw makeup water for the 600-psig boilers contains 230 ppm bicarbonate, 30 ppm silica, practically zero hardness, and about 3 ppm of naturally occurring phosphate. Hydrogen cycle exchangers reduce the high alkalinity, while the following treatment with caustic soda and magnesium sulfate and oxide in the hot process unit reduces the silica concentration of the filter effluent to about 2 ppm.

Hall engineer C. F. Raines decided to try a Hagan Coagulant Aid for better settling of suspended matter in the hot-process unit, even though there had been no previous experience with the Hagan aid for such an application.

A few ppm produced amazing results. The effluent from the unit was clear even before filtration and the filter effluent was sparkling clear.

In addition to reducing sludge carry-over, the 8-10 ppm coagulant aid feed resulted in the same degree of silica removal with 15 per cent less magnesium salts.

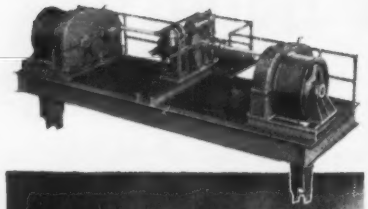
Both the plant operating staff and engineer Raines are justifiably pleased with the truly outstanding improvement in water conditions.

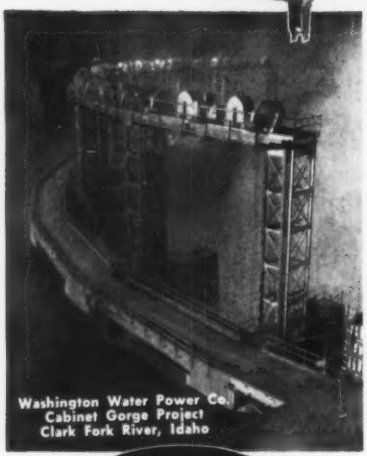
Industrial Water Problems Require Special Handling

There are no "stock answers" to industrial water problems. For information write, wire or call Hall Laboratories, Division of Hagan Chemicals & Controls, Inc., Hagan Building, Pittsburgh 30, Pa.

Water is your industry's most important raw material. Use it wisely.

Hall Laboratories—Consultants on Procurement, Treatment, Use and Disposal of Industrial Water





MURCO

GATE HOISTS

for any Size Power Dam

Designed and built in a wide range of capacities from less than one ton to over one hundred tons . . . from the smallest hand operated to the largest motor operated gate hoist, MURCO Gate Hoists have behind them over sixty years of designing and building experience. During that time we have developed many designs and patterns. In planning gates and gate hoists, we suggest you write us before your overall plans are complete . . . it may save you time and money. We may have designs and patterns to fit your special requirements.

Write for complete information and Engineering Department recommendations to meet your specific power dam requirements.

D. J. MURRAY MANUFACTURING CO.

Manufacturers Since 1883

WAUSAU · WISCONSIN

More TECHNICAL BRIEFS

Begins on page 156

Power reactor development program in the Netherlands. *By J J Went, Arnhem, Netherlands.*

Technical, economical and safety considerations, will determine the types of nuclear reactors to be developed for power production.

The Netherlands power reactor development program involves liquid fuel reactors with wet or dry suspensions of uranium- (thorium-) oxides in heavy water respective in gas.

Some general properties of the wet suspension reactor, now in construction as a small prototype, are discussed. *WPC paper No. 201J14.*

Refrigeration

A survey of possible refrigerants for high-temperature application. *By J Van Winkle, General Electric Company.*

The refrigerant study described in this paper was the result of a 6-month survey of materials which could be used in a conventional vapor-cycle system operating at the high sink temperatures required in supersonic airframes. Since the operating conditions are so stringent, it is necessary to consider elements and mixtures of elements as well as ionic and organic compounds. Of the materials considered, mercury, the alkali metals, and certain higher molecular-weight Freon-like compounds appear to have the best promise. Practical consideration of the reactivity of the alkali metals militates against their use. *ASME paper No. 56-SA-12.*

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from the following sources unless otherwise stated. Order complete paper from source, not POWER.

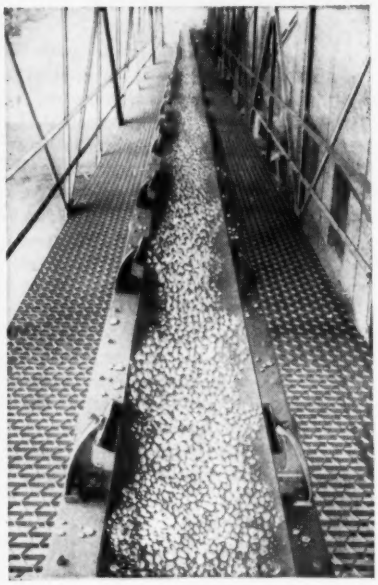
American Society of Mechanical Engineers. Identified by initials ASME and obtainable through ASME, 29 W 39th St, New York 18, New York.

American Institute of Electrical Engineers. Identified by initials AIEE and obtainable through AIEE, 33 W 39th St, New York 18, New York.

World Power Conference, 5th meeting, identified by initials WPC. Information as to availability obtainable from Oesterreichisches Nationalkomitee der Weltkraftkonferenz, Vienna 1, Schwarzenbergplatz 1, Austria.

STUMBLING HAZARD ELIMINATED

Spilled materials on a solid walkway caused workmen to stumble and turn ankles. Installation of 80% open Irving Mesh Grating allowed materials to fall through and minimized the hazard.



★

For Safe, Strong, Slip-Proof Stair Treads Specify

IRVING "VIZABLEDG" TREADS

★

Manufacturers of Riveted, Pressure-Locked, and Welded Gratings of Steel, Aluminum and other metals.

"A FITTING GRATING FOR EVERY PURPOSE"

IRVICO

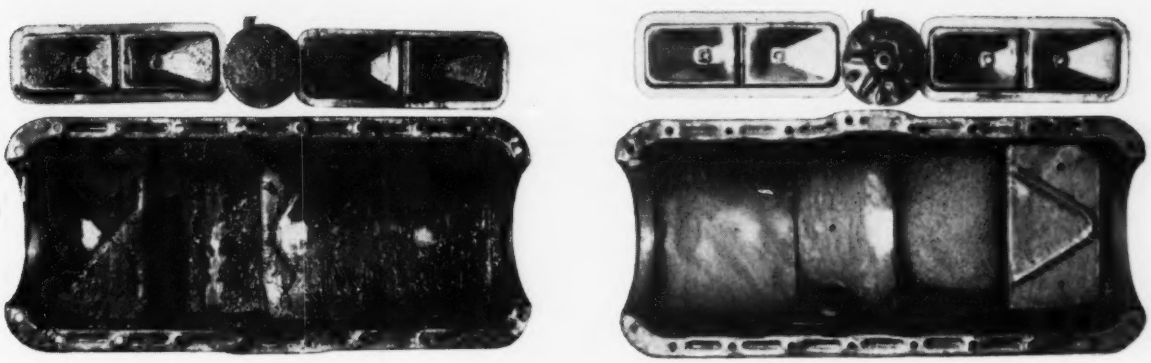
IRVING SUBWAY GRATING CO., Inc.

Originators of the Grating Industry

Offices and Plants at
5002 27th St., LONG ISLAND CITY 1, N. Y.
1802 10th St., OAKLAND 23, CALIFORNIA

PROOF POSITIVE...

of SINCLAIR Diesel Oil Superiority!



This is actual photographic proof of the superiority of Sinclair Diesel Lubricants. On the left is a truck engine sump in which an ordinary oil was used. The clean sump on the right reflects conditions when a Sinclair Diesel Oil, SUPER TENOL, was used. This same top quality lubrication performance can be expected from all Sinclair Diesel Oils . . . *because Sinclair has the exact oil to match your engine's requirements!*

Sinclair RUBILENE® – These high viscosity index oils, refined by Sinclair's famed Phetone Process, have a long history of outstanding performance and are extensively used in stationary Diesel power plants today.

Sinclair RUBILENE HD – These high viscosity index oils contain additives which provide excellent detergent – dispersant properties, oxidation resistance, bearing corrosion prevention and anti-foam qualities. They are especially suitable for stationary Diesels as well as the higher speed Diesels used in industrial plants.

Sinclair GASCON® – These naturally detergent, straight mineral oils are recommended for slow, medium and high speed Diesels where carbon deposits, engine cleanliness and easy, low temperature starting is important.

Sinclair GASCON HD – Heavy duty detergent type oils compounded with selected additives to provide extra detergent dispersant properties, bearing corrosion prevention, oxidation resistance and anti-foam characteristics.

Sinclair TENOL®, SUPER TENOL and TENOL EXTRA – A series of heavy duty, detergent–dispersant type, high viscosity index oils refined by the Sinclair Phetone Process. Recommended for all high speed automotive fleet Diesel engines, and for some engines of late design in stationary, portable and marine service. All three series contain varying degrees of additive concentrations necessary to give outstanding performance no matter what the service condition under which your Diesel operates.

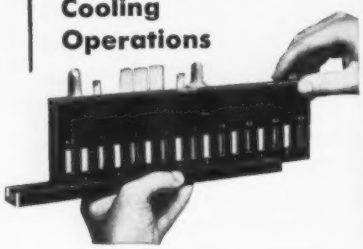
For further information about Sinclair's trouble-proof Diesel lubricants, see your Sinclair Representative, or write Sinclair Refining Company, Technical Service Division, 600 Fifth Avenue, New York 20, N. Y. *There's no obligation.*

SINCLAIR

DIESEL OILS

TAYLOR COMPARATORS

Help you maintain
UNIFORM
pH, PHOSPHATE, NITRATE LEVELS
for trouble-free
Boiler, Condenser, Cooling Operations



Accurate, on-the-spot colorimetric tests for pH, phosphate, nitrate or sulfite made with Taylor Comparators give you dependable data in minutes . . . help you control scaling, corrosion, embrittlement or sliming.

Determinations are made in only three easy steps. Every set includes complete instructions, all necessary accessories and reagents. Complete water analysis including silica and hydrazine only a little more detailed with the Taylor Water Analyzer.

To determine water hardness quickly, yet with ease and accuracy of an alkalinity titration, use the Taylor Total Hardness Set.

COLOR STANDARDS GUARANTEED

Be sure to use only Taylor reagents and accessories with Taylor Comparators to assure accurate results. All Taylor liquid color standards carry an unlimited guarantee against fading.

SEE YOUR DEALER for Taylor sets or immediate replacement of supplies. Write for FREE HANDBOOK "Modern pH and Chlorine Control". Gives theory and application of pH control; illustrates and describes full Taylor line.

W. A. TAYLOR AND CO.
YORK RD. & STEVENSON LANE • BALTO. 4, MD.

More EQUIPMENT NEWS

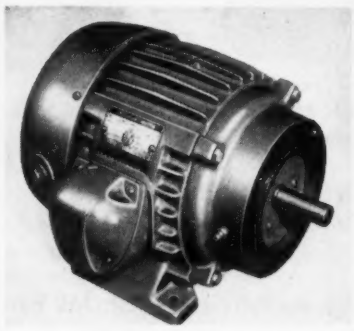
Begins on page 160

Current-limiting reactors

420 • New ratings of *RM* current-limiting reactors are designed to line up electrically with switchgear and feeder voltage regulators of standard ratings. Higher current ratings, 1200 and 2000 amps, have been added for use with switchgear of these standard ratings.

Extended line of *RM* reactors comes in two voltage classes, 5 and 15 kv, either single or three-phase, for indoor or outdoor use. Reactors are of cast-in-concrete construction, have aluminum conductors, and blade type terminals of either aluminum or copper, depending on the user's bus. Request details from the manufacturer.

General Electric Company
Schenectady 5, N. Y.

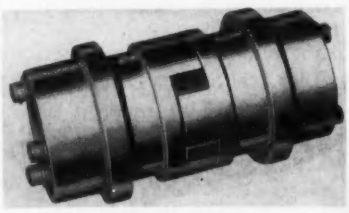


Totally-enclosed motor

422 • Unit has facilities for mounting driven equipment directly to motor. Accurate alignment is provided by means of a totally-enclosed NEMA style-C bracket with tapped holes for bolting from the driven equipment side. Designed to new dimension standard of NEMA, motor has more hp in less space, according to manufacturer. Designated *Type J*, motor is available in ratings of 1 to 30 hp. Further details on request to manufacturer.

U.S. Electrical Motors, Inc
Box 2058, Terminal Annex
Los Angeles 54, Calif.

For more details on these items, use post cards p 169. Identify your request with item number.



Flexible coupling

435 • Radially removable flexible coupling provides a simple means of disconnecting two units without axial movement of the shafts. (*Continued on page 214*)

Stop Corrosion
in boilers, steam and return lines . . .
with this Stickle deaerating feed water heater

SAVES STEAM
Vent Condenser releases only air and contaminated gases to atmosphere
NO CONTAMINATION
Counterflow of steam and water prevents reabsorption of oxygen
SELF-CLEANING
There is no need for removable baffles or trays

Stickle Baffle Spray Type Deaerating Feed Water Heaters stop corrosion by removing destructive oxygen and carbon dioxide from boiler feed water . . . reduce fuel costs and boiler strain. Vertical and horizontal models. Capacity range: 3,000 to 300,000 pounds per hour. The latest development in more than 50 years of building feed water heaters.

FREE CATALOGS!
S-217 . . . Baffle Spray Type Deaerating Feed Water Heaters
117 . . . Open Coil Feed Water Heaters

STICKLE STEAM SPECIALTIES CO.
2265 Valley Ave. • Indianapolis 18, Ind.

Stickle Equipment
Cuts the cost of steam

STRONGER and SAFER for every high pressure pipeline duty...

...because they are **drop forged by Vogt**

Send for Catalog F-9

Constantly imitated but never duplicated, Vogt drop forged steel fittings and flanges have unmatched strength and toughness for your most severe pipeline duties. Laboratory controlled materials and Vogt's special forging techniques assure products which are always uniform in structure, fine grained, and free from porosity. Thereby the shocks and stresses imposed by high pressures and high temperatures are easily withstood, and with stubborn resistance to erosion and corrosion. Consult Catalog F-9 for our complete line of fittings and flanges.

For a copy of Vogt Catalog F-9 address Dept. **24A-FP.**

HENRY VOGT MACHINE CO., P.O. BOX 1918, LOUISVILLE 1, KENTUCKY

SALES OFFICES: New York, Chicago, Cleveland, Dallas, Philadelphia, St. Louis, Charleston, W. Va., Cincinnati,

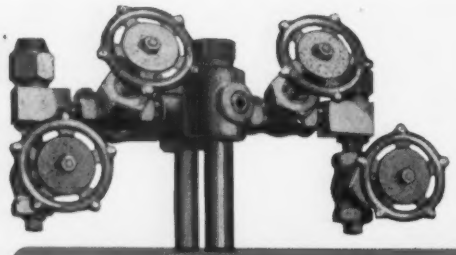
OTHER VOGT PRODUCTS

Drop Forged Steel Valves — Petroleum Refinery and Chemical Plant Equipment — Steam Generators — Heat Exchangers — Ice Making and Refrigerating Equipment.

Vogt

DROP FORGED STEEL

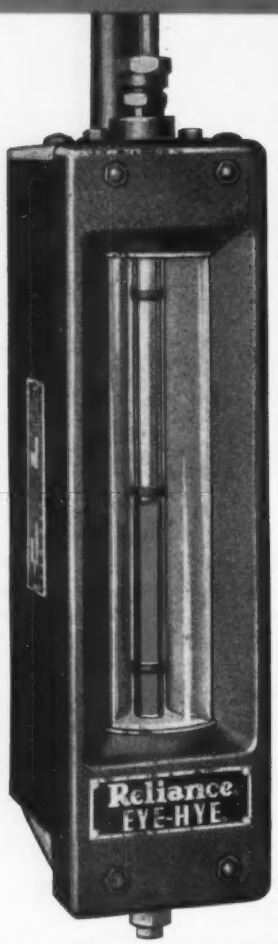
Fittings and Flanges



Models for panel or wall mounting

"Wouldn't operate my plant without them" says St. Louis engineer, of his

EYE-HYE® Remote Reading Indicators



This Reliance Gage, completely hydrostatic, assures safe, accurate reading of your boiler water levels

Here is easy natural reading (like conventional water gages) with perfect measurement and constant dependability. Twenty years on the market, and still increasing in use, here and abroad.

Simple as A-B-C, EYE-HYE indicates water level clearly by illuminated green fluid. Newly styled face plate gives wider angle of vision. And for extra safety, optional equipment adds auxiliary light signals and/or vibratory horns, reaching operators anywhere.

EYE-HYE serves main boilers — any pressure — and various power plant tanks and vessels in out-of-the-way places. Two EYE-HYEs are now acceptable under Boiler Code Case No. 1155 — eliminate maintenance of extra gage glass.

Rugged construction; no mechanical working parts; no adjustments on location; easy to maintain. Write for Bulletin CO today.

The Reliance Gauge Column Company • 5902 Carnegie Avenue • Cleveland 3, Ohio

More EQUIPMENT NEWS

Begins on page 160

Manufacturer claims that this coupling simplifies maintenance and is ideal for applications where driven equipment such as a pump must be disconnected while the driving unit continues to operate. Unit is said to be maintenance and lubrication free. Request details from manufacturer.

Lovejoy Flexible Coupling Co
4896 W Lake St, Chicago 44, Ill.

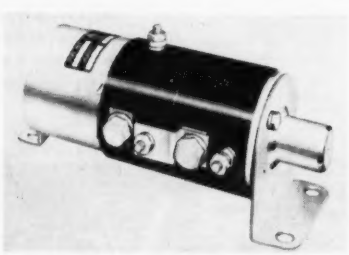
Portable generator

423 • Two 1500-watt models feature vertical shaft design. With vertical shaft, entire weight of generator is supported by tubular framework. Weight loads normally imposed on main bearing shaft in conventional horizontal designs are shifted completely to framework.

Manufacturer claims that simple shock mounting isolates rotating armature action and engine vibration from frame. Units weigh 95 lb, are 23¾ in. high and 23 in. in dia. Each has a 4-cycle, single cylinder, air-cooled engine with automatic rewind starter. Details on request.

Thor Power Tool Company
181 N State, Aurora, Ill.

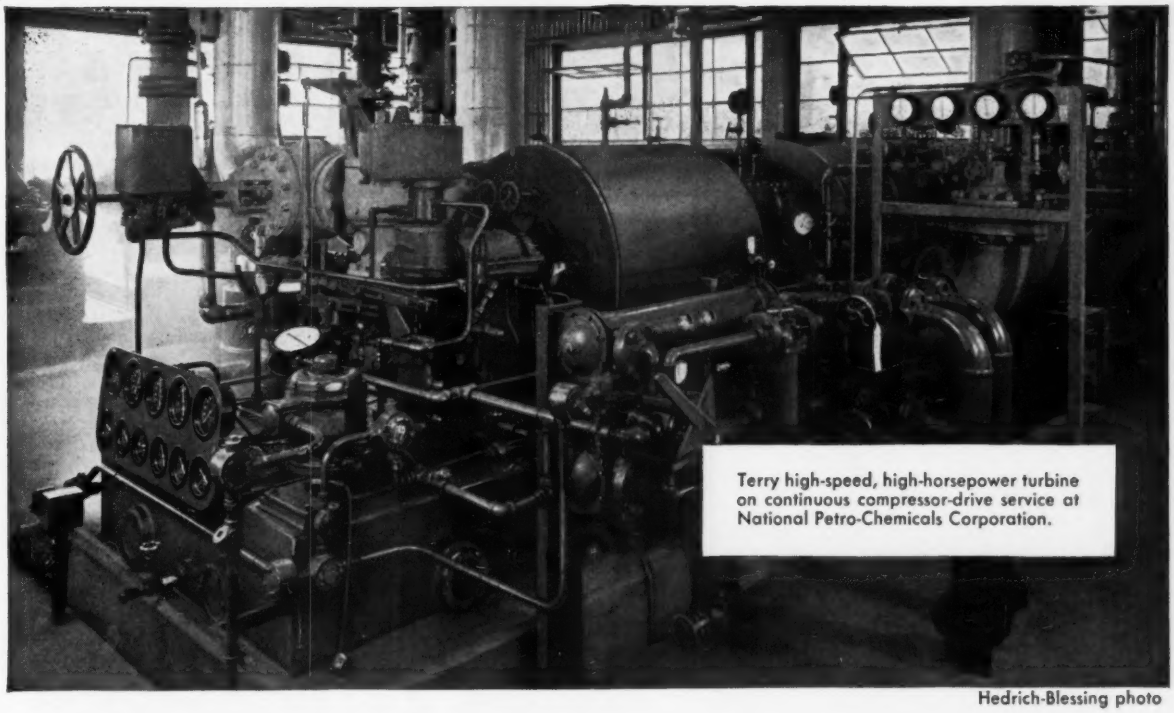
For more details on these items, use post cards p 169. Identify your request with item number.



Heavy duty switches

432 • Line of heavy-duty series-parallel switches features both 12 and 24 volt models. Units make possible the use of 24 volts for starting motors on vehicles and engines having 12-volt electrical systems.

Additional features include either

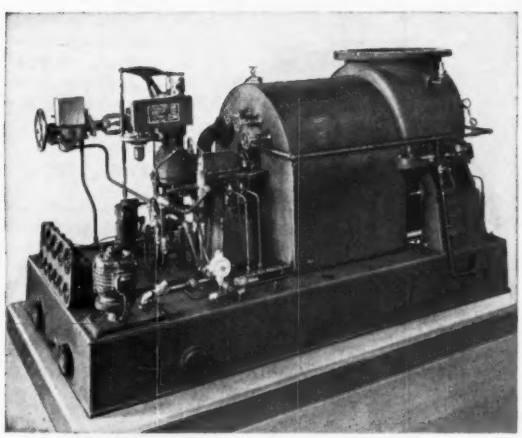


Terry high-speed, high-horsepower turbine on continuous compressor-drive service at National Petro-Chemicals Corporation.

Hedrich-Blessing photo

At National Petro-Chemicals Corporation . . .

Terry high-speed compressor-drive turbines provide continuous 'round-the-clock service



One of the two 5400 hp., 7486 rpm turbines built for the Tuscola plant of National Petro-Chemicals Corporation.

In the fall of 1953, five Terry multistage turbines were placed on day-and-night duty at the Tuscola, Illinois, Plant of National Petro-Chemicals Corporation. They drive high-speed compressors used to compress hydrocarbon gases in the production of ethylene.

The *excellent performance of these initial units later resulted in the installation of two more Terry machines.* These were placed in service some two years later.

In all, the seven turbines total more than 30,000 hp. They range in capacity from 3300 to 5400 hp., and in speed from 7500 to 9700 rpm.

The National Petro-Chemicals installation, and the thousands of other units serving in refineries and chemical plants throughout the world, are testimony to the low maintenance and consistent reliability of Terry turbines. Put Terry to work for you. Write for further information.

THE TERRY STEAM TURBINE CO.

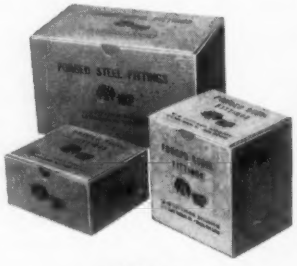
TERRY SQUARE, HARTFORD 1, CONN.

TERRY

TT-1207

NOW *a Modern Fittings Package*

one more reason for specifying
W-S FORGED STEEL FITTINGS



W-S Forged Steel Fittings are now being shipped in strong, lightweight fiberboard cartons designed to make purchasing a pleasure. Shipments are made up of unit cartons packaged inside a larger reinforced carton. It's easy... and advantageous to order your fittings in packaged quantities.

Here are additional advantages of the new W-S package:

1. Compact and easy to handle.
2. Ideal for neat, efficient stacking on warehouse and stockroom shelves.
3. Sealed against dust and moisture.
4. Contents clearly marked on outside face of each carton, readily visible for prompt identification.

The new W-S package is only one of many reasons why W-S Forged Steel Fittings are the most widely accepted by industry.

Don't forget, too, W-S carbon steel fittings have the additional protection of their new blue synthetic coating. For detailed information on packaged lots ...and for a copy of our new fittings catalog, write today to W-S Fittings Division, H. K. Porter Company, Inc., Roselle, N. J.

Sold Through Leading Distributors

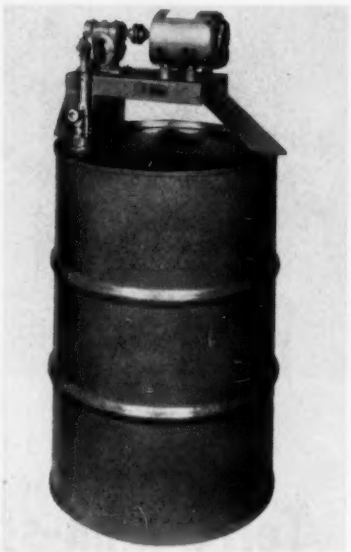
HKP W-S FITTINGS DIVISION
H. K. PORTER COMPANY, INC.

More EQUIPMENT NEWS

Begins on page 160

splashproof or waterproof construction; special design prevents short circuiting from contact welding and, thus, eliminates the need for fuses or circuit breakers, says manufacturer. Details on request.

Leece-Neville Co
1374 E 51 St, Cleveland, Ohio



Controlled volume pump

430 • Pump for barrel head mounting meters toxic or corrosive chemicals from up-right, 55-gal barrels against pressures up to 100 psi. Available in maxium capacities from 500 milliliters per hour to 4 gal per hour, the portable barrel pumps have constant speed, 1/3 hp, 115-volt, 60-cycle motors. Capacities are adjustable from zero to maximum. Repetitive pumping accuracy of these barrel pumps is 1%.

Milton Roy Company
1300 E Mermaid Lane, Phila. 18, Pa.

For more details on these items, use post cards p 169. Identify your request with item number.

400-cycle heating unit

427 • Induction type heating unit, 400 cycle, permits preheating and stress re-

Tapered for positive suspension.
High radial sealing surface.
"Tongue and groove" for easy installation.
Clearance for radial motion.

KOPPERS HUHN CARBON RING

Reduces Steam Loss as much as 90%!

The unique design of Koppers Huhn Carbon Ring reduces steam loss far below the customary 1% loss of labyrinths and carbon garter spring rings. Huhn Carbon Ring keeps steam loss as low as ¼ of 1% . . . often as little as 1/10 of 1%. Using your own figures for steam costs, you can easily discover how much Koppers Huhn Carbon Rings can save you annually.

The design assures you continuous radial sealing . . . because a radial sealing surface is always forced against a chamber wall. Automatic suspension . . . even during shutdowns . . . prevents shaft contact, reduces wear, and prolongs life. The Huhn Carbon Ring operates with peak efficiency at highest shaft surface speeds and highest operating temperatures.

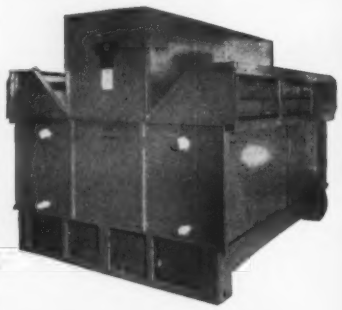
Koppers Huhn Carbon Ring replaces labyrinths and carbon garter spring rings in compressors, and steam and water turbines. Steam savings alone often pay within a year for the cost of replacement. Discover now how Huhn Carbon Rings reduce steam and fluid losses and minimize operating, maintenance and repair costs. Write: KOPPERS COMPANY, INC., *Piston Ring and Seal Dept.*, 2104 Hamburg St., Baltimore 3, Md.

Koppers Company, Inc.
Metal Products Division
Piston Ring and Seal Dept.

***Engineered* Products**
Sold with *Service*

KOPPERS®

MECHANICAL SHAFT SEALS



NIAGARA SECTIONAL *Aero* HEAT EXCHANGER gives close temperature control, saves you LABOR, Power, Water

- **Because the new design improves the heat transfer to the out-door air by evaporation.**
- **Because new features keep your equipment working for long life with "new plant" efficiency . . . always full capacity.**
- **Because you save 95% of cooling water cost.**

You get faster, more accurate cooling of industrial fluids to specified temperatures.

You improve your quality of production by removing heat at the rate of input.

You save labor in upkeep. With full access to all interior parts and piping you see everything in easy inspections. You head off dirt accumulation and corrosion. Casing panels are removable without moving the coils. The coils can be cleaned from both sides.

First cost is low; freight is low because of the lowest space/weight ratio; you save much labor in erection. Capacity range is 7,000,000 to 18,000,000 Btu/hr. No other heat exchange method gives you so much saving in money and convenience.

Write for Niagara Bulletin No. 132

NIAGARA BLOWER COMPANY
Dept. P-4, 405 Lexington Ave.
NEW YORK 17, N. Y.

District Engineers in Principal Cities of U. S. and Canada

More EQUIPMENT NEWS

Begins on page 160

lieving in one continuous cycle without moving the weldment for furnace treatment or other operation. Unit is adjustable to any desired schedule of heating, soaking and cooling rates, and when preset to a particular program, provides fully automatic and continuous control of temperature during processing.

Controlling instrument heats to preheat temperature and holds it accurately until welding begins. When weld is completed, the instrument automatically starts the desired stress relieving program.

Hobart Bros Co
Hobart Square, Troy, Ohio

Circuit breakers

434 • Compact, 240-volt plug-in circuit breakers, half the size of the conventional E frame, are suited for applications on lighting and power circuits from 15 to 50 amp. These two and three pole breakers utilize standard 1-in. TQL modulus. Breakers plug into all *GE* 3-phase service entrance load centers and lighting panelboards. Request details from maker.

General Electric Company
Plainville, Conn.

For more details on these items, use post cards p 169. Identify your request with item number.

Aluminum welding fittings

425 • Company's engineers have designed welding fittings which permit putting substation A-frames together with straight-cut lengths of tubing—no bias cutting, nor layout for fancy intersections. It is not necessary to make jigs for field welding, to facilitate aligning buses in the air, and minor differences are taken care of, according to manufacturer.

With these fittings, manufacturer says that only a hack saw and welding outfit

protect YOUR INVESTMENT *with a* TIME TESTED LINE OF LUBRICANTS . . ALBANY LUBRICANTS

PAST PERFORMANCE IS YOUR ASSURANCE OF FUTURE SATISFACTION

ALBANY PRESSUREGREASE UNIVERSAL
For Cups — Ball Bearings — Water Pumps — Universal Joints. Waterproof — Exceptionally high melting point. Soft enough for gun application.

ALBANY GREASE
A cooling lubricant in 3 consistencies for operating temperatures from 110° F to 200° F.

ALBANY PRESSUREGREASE
A superior waterproof mineral oil grease of high viscosity. Comes in Liquid, Soft, Medium, Hard and Graphite. Pressuregrease Soft and Medium.

ALBANY BEARING LUBRICANT
(Ball or Roller Bearing)
Will not separate or oxidize assuring long life to bearings. May be used in hand grease guns.

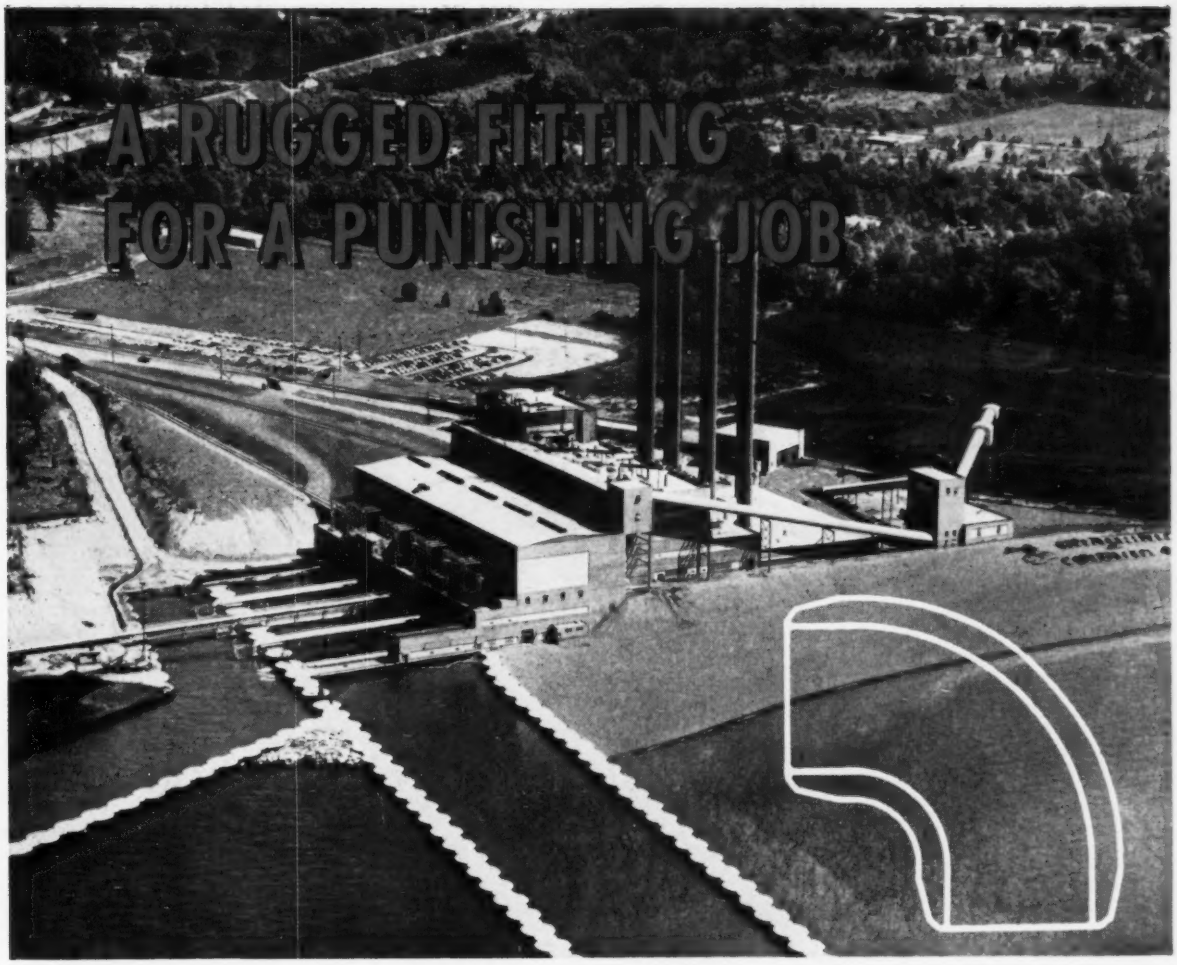
ALBANY GEAR LUBRICANTS
Retard wear, quiet gears. Waterproof. Will not drip when gears are idle or in motion.

ALBANY PENETRATING OILS
(Clear or Graphite)
Quick-acting. Cut rust as well as lubricate. Loosen sticky valves, eliminate squeaks.

Order Albany Lubricants through your supply house.

Serving industry throughout the world since 1868.

ADAM COOK'S SONS, INC.
Mfrs. of Albany Lubricating Products
LINDEN, NEW JERSEY



Extra Strong KEY-KAST 90° Ells Serve Heater at Cleveland Electric's Eastlake Power Plant

Steam lines leaving a desuperheater at The Cleveland Electric Illuminating Company may be subjected to abnormal erosion conditions.

To provide the durability needed to withstand this punishing treatment, 12" extra strong KEY-KAST 90° butt welding elbows were installed.

Long life and high resistance to wear are characteristic of all KEY-KAST fittings . . . manufactured under strict metallurgical control and available in all shapes, sizes and schedules to serve your piping needs better.

JOB DETAILS

User:	The Cleveland Electric Illuminating Company Eastlake Plant, Eastlake, Ohio
Customer:	Pittsburgh Piping & Equipment Company
Fabricator:	Pittsburgh Piping & Equipment Company
Fittings:	12" extra strong KEY-KAST 90° butt welding elbows
Material:	5% Chrome, ½ % Moly, ASTM SPEC A-217 GR C5
Service:	Adjoining desuperheater
Conditions:	Severe corrosion and erosion Steam 438 PSIG @ 700°F.

W-K-M
DIVISION OF acf INDUSTRIES INCORPORATED

Plant: Missouri City, Texas • Mailing Address: P.O. Box 2117, Houston, Texas

MANUFACTURING

KEY RETURN BENDS AND FITTINGS

W-K-M THROUGH-CONDUIT GATE VALVES

acf LUBRICATED PLUG VALVES

KIRK & BLUM

SHEET and PLATE FABRICATION for POWER PLANTS

Whatever your requirements in sheet and plate fabrication . . . such as the mammoth breeching section shown here . . . call on KIRK & BLUM.

During the past 50 years, Kirk & Blum has acquired exceptional experience and complete facilities for fabricating carbon steel, stainless, aluminum, monel and other alloys up to ½" thickness.

Send prints for prompt quotations on your requirements, or write for your copy of the latest Kirk & Blum Sheet and Plate Fabrication Booklet.

- BREECHINGS • STACKS • AIR and GAS DUCTS
- CASINGS • LOUVERS • BINS and HOPPERS
- INSULATION JACKETING
- ALUMINUM and ALLOY FABRICATION
- CONTROL PANELS and DESKS

THE KIRK & BLUM MFG. CO.

3233 Forrer Street, Cincinnati 9, Ohio

More EQUIPMENT NEWS

Begins on page 160

are needed to put up a substation.

Aluminum connections for welding the A-frame members together have cylindrical bosses, at correct angles to take the tubes. In field erection, all that's necessary is to insert straight lengths of tubing into these bosses and weld the A-frame. Complete information available from manufacturer.

Penn Union Electric Corp
State St, Erie, Pa.

Differential pressure switch

431 • Switch is designed to make or break electrical circuits when difference between two pressures is equal to or greater than a predetermined value.

Switch features low and high operating pressures of 250 psig and 500 psig respectively and weighs 75 lb. Pressure differential is sensed by a diaphragm type capsule designed to withstand high overpressure without sacrificing sensitivity. Request details from the manufacturer.

Gulton Industries, Inc
200 Durham Ave, Metuchen, N. J.

For more details on these items, use post cards p 169. Identify your request with item number.

Heating circulating system

426 • System is designed especially for No. 6 oil. According to manufacturer, it does three things: keeps oil in continuous circulation, compensates for variable viscosity and heats burner nozzle.

Operation of viscosity compensator is made possible by fact that the oil transfer pump will provide it with a constant flow of oil. Details from the manufacturer.

York-Shipley, Inc
75 Jessop Place, York, Pa.

Radiant heat gas burner

428 • Gas burner provides a large radiant heat surface and high rate of heat transfer without flame impingement according to manufacturer.

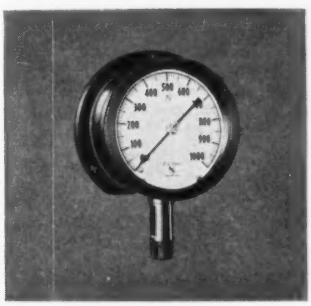
Burner utilizes any commercial fuel gas and provides mixing of air and gas at stainless steel nozzle outlet. With short flame length and low forward velocity of

Why does the BOURDON TUBE in the ASHCROFT DURAGAUGE insure sustained accuracy?

FOR FAST SERVICE, get in touch with your Industrial Supply Distributor. He is fully acquainted with Ashcroft Duragauges and their proper selection for all kinds of applications.

8 TUBE MATERIALS permit selection of the *best metal* for particular service conditions. These materials include phosphor bronze, alloy steels, "K" Monel, stainless steels, and beryllium copper.

Every Bourdon tube used in the Ashcroft Duragauge is extra-wide – highly sensitive to slight pressure changes. Socket and tip joints are welded or brazed, then stress relieved after assembly, to assure maximum safety and uniform structure for highest corrosion resistance and strength. Each tube assembly is "whip tested" at pulsating pressures approximately 50% higher than its pressure rating to insure calibration stability.



The Ashcroft Duragauge is available with all-stainless-steel movement or stainless steel with nylon bearings and pinion gear. A choice of case designs and materials, dial sizes and pressure ranges readily satisfy the most exacting requirements. Whatever the working pressures or corrosive conditions of your operations, specify Ashcroft Duragauges and be sure of highest sustained accuracy and long service life.

1850 ASHCROFT U.S.A.

In Canada: *Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario*

ASHCROFT GAUGES

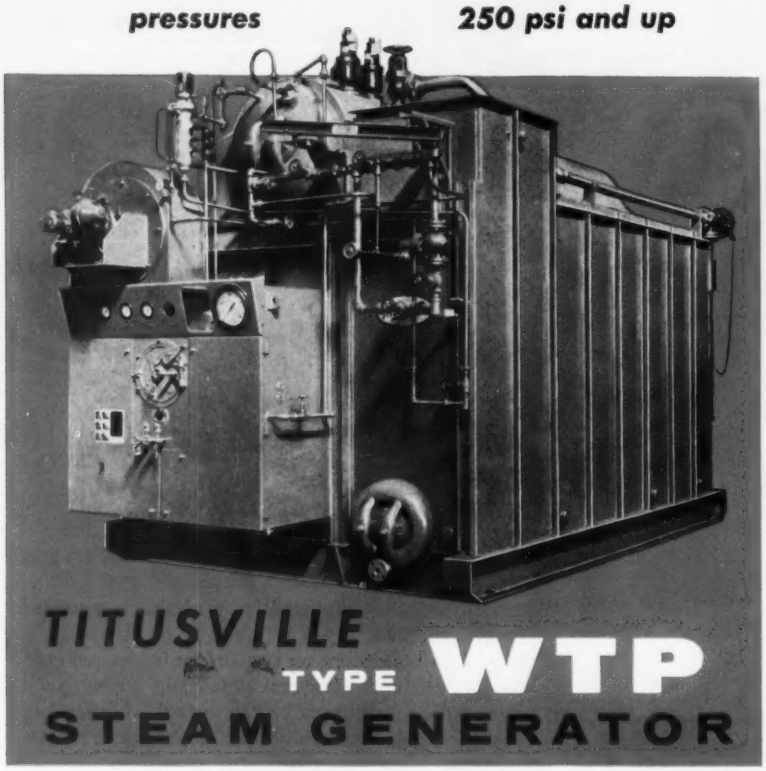
A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, *Stratford, Conn.* 'HANCOCK' VALVES, *Watertown, Mass.* 'CONSOLIDATED' SAFETY RELIEF VALVES, *Tulsa, Oklahoma.* AIRCRAFT CONTROL PRODUCTS, *Danbury & Stratford, Conn. and Inglewood, Calif.* "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Mich.*

PERFORMANCE

Meeting Your Most Rigid Requirements—in Capacities to 50,000 lbs.

pressures 250 psi and up



TITUSVILLE TYPE WTP STEAM GENERATOR

Tops in steam generating performance is matched by outstanding dependability in Titusville's Type WTP Water Tube Steam Generators. Completely factory-assembled, ready to ship by flatcar or truck trailer, Type WTP is easy to install in your boiler-room. • Let us show you why and where Type WTP is serving many of the toughest boiler assignments in the country. When writing, ask for Bulletin 5511.

THE TITUSVILLE IRON WORKS CO.

BOILER DIVISION
BOILERS for Power and Heat . . . High and Low Pressure . . . Water Tube . . . Fire Tube . . . Package Units

PROCESSING EQUIPMENT DIVISION
Crystallizers . . . Direct Fired Heaters . . . Evaporators . . . Heat Exchangers . . . Mixing and Blending Units . . . Quick Opening Doors . . . Special Carbon and Alloy Processing Vessels . . . Synthesis Converters

FORGE DIVISION
Crankshafts . . . Pressure Vessels . . . Hydraulic Cylinders . . . Shafting . . . Straightening and Back-up Rolls

MACHINERY DIVISION
MACHINERY for Sheet and Structural Metal Forming . . . Tangent Benders . . . Folding Machines . . . Roller Table and Tumble Die Bending Machines . . . Press Brakes . . . Punching and Notching Machines . . . Forming Dies

A Division of

Struthers Wells

TITUSVILLE, PENNSYLVANIA

Manufacturers of A Complete Line of Boilers for Every Heating and Power Requirement

Plants at Titusville, Pa. and Warren, Pa.

Offices in Principal Cities

More EQUIPMENT NEWS

Begins on page 160

combustion gases, heat can be distributed more uniformly and directed in required areas through roof walls or bottom of furnaces, according to manufacturer. Turndown ratio is more than 10 to 1, depending on air pressure. Burner may be controlled manually, or by automatic pressure proportioning control or automatic mechanical control.

Unit is suited for many heat processing applications in steel, nonferrous and ceramic furnaces and in chemical heat reaction equipment. Request full details.

Hauck Manufacturing Company
124-36 10th St, Brooklyn, N. Y.

Gage protector

433 • Diaphragm-type gage protector is designed to protect gages from pressure surges. Unit has fast response to pressure changes and will automatically cut out the gage and by-pass the working media when line pressures rise above the spring setting in the protector, according to manufacturer.

Especially suited to air or poisonous gas service, protector has an external pressure adjusting control which permits accurate pressure settings from 10 to 100 psi.

Units are available with ¼ in. FPT part connections and are constructed with corrosion resistant brass bodies.

Superior Hydraulics Div, 15201
St. Clair Ave, Cleveland, Ohio

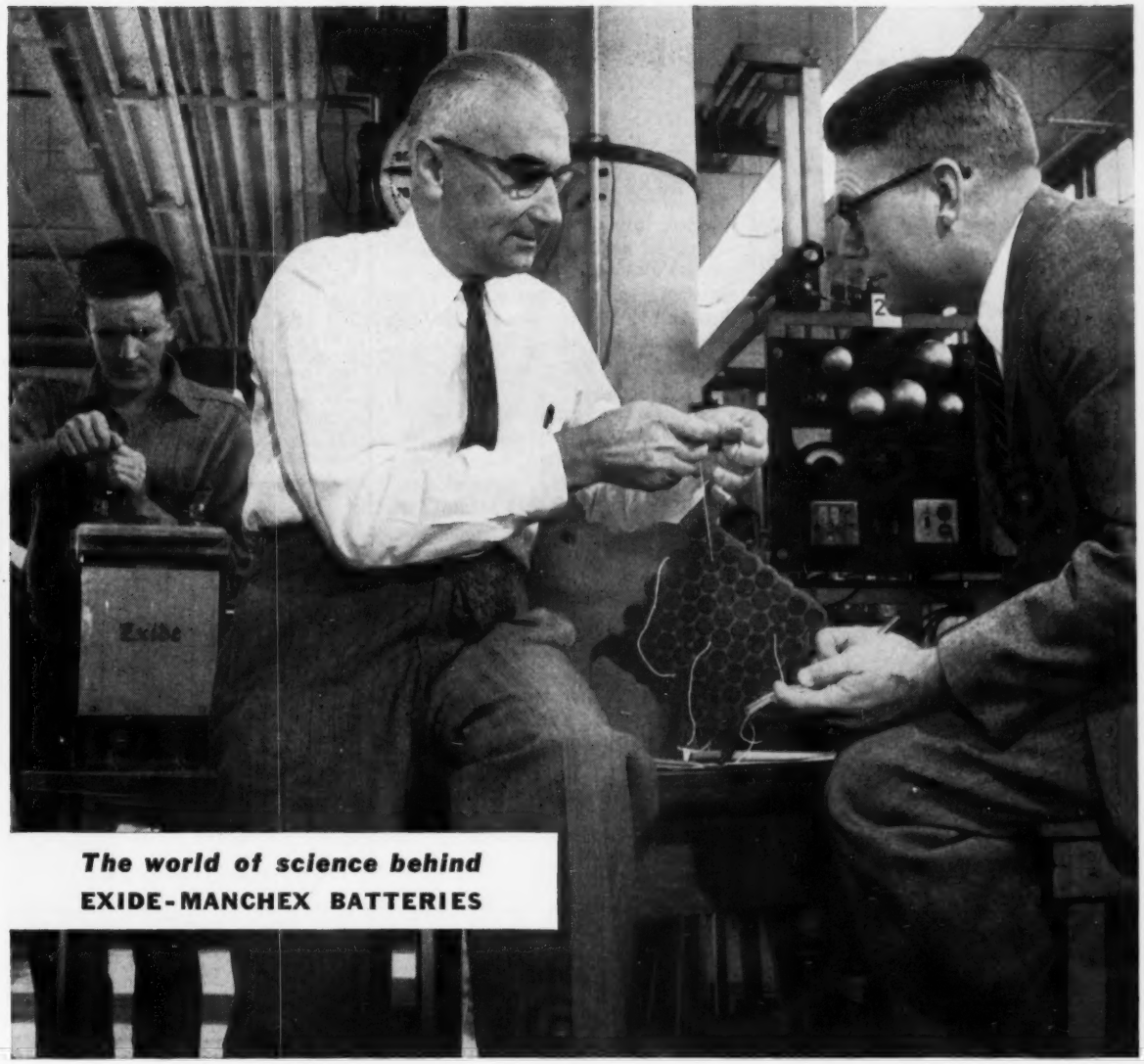
For more details on these items, use post cards p 169. Identify your request with item number.

Steam service valve

421 • Pressure-reducing and regulating valve for steam service features built-in pilot and main valve strainers. Unit is a single-seat internal pilot-operated piston-actuated model which, according to manufacturer, is highly responsive and sensitive to the smallest changes in reduced pressure. Strainers may be cleaned or replaced without removing valve from line.

Maximum inlet pressure is 250 psi at 400 F; delivery pressures range from 5 to 250 psi. Unit is also available with external sensing line. Sizes are 2, 2½, 3 and 4 in. with iron body and flanged ends.

A W Cash Co, Box 551
Decatur, Ill.



The world of science behind
EXIDE-MANCHEX BATTERIES

Being interviewed is R. R. Jardine, Supervisor of Development Engineering

"Open windows let electrolyte in—power out"

At the Exide Laboratories—**Reporter:** You mean there's an important connection between the electrolyte and the battery power?

Jardine: Yes indeed. You see how I'm running these strings through the "windows" in the Exide-Manchex positive plate? These openings give the electrolyte free access deep into the interior of the plate.

Reporter: How does that affect battery performance?

Jardine: It means there's no time lag—no slow filtering of the electrolyte to reach the active material. There's a continuous contact between the electrolyte and the entire plate. So the power is there when it's called for.

Reporter: Do other batteries have this free access of electrolyte to the active material?

Jardine: No they don't. Because only the Exide-Manchex has the positive plate with the spiral lead buttons locked into a cast alloy grid.

Reporter: Obviously this is an important feature of the Exide-Manchex Battery.

Jardine: Yes it is, but it's just one of many engineering details that contribute to their long life and high capacity.

Note to battery users: When you order batteries for float or cycle service in stationary applications, be sure to specify Exide-Manchex. Write for detailed bulletin. Exide Industrial Division, The Electric Storage Battery Co., Philadelphia 2, Pa.

THE ELECTRIC STORAGE BATTERY COMPANY **Exide®**

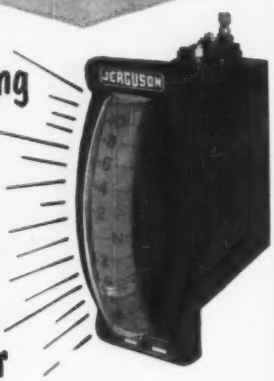
Here's Jerguson's

New!

RED FLASHER TRUSCALE

Remote Reading Liquid Level Gage

Flashing Red Scale Warns of Danger



Jerguson Truscales are now available with a unique new safety feature. Illuminated scale starts flashing red if boiler water level gets too high or too low. This positive warning flashes continuously until the dangerous condition is corrected.

Truscales offer the greatest possible protection for expensive equipment. They give instant remote reading of liquid level of boilers, tanks, etc., with the amazing accuracy of ½ of 1% of scale reading. Convex face, with scale markings directly on it, gives 180° visibility. It's easy to take readings from any point from which the face can be seen.

Protect valuable equipment with Jerguson Truscale Remote Reading Gages. Send for new 8-page bulletin which gives complete details.

JERGUSON

Gages and Valves for the Observation of Liquids and Levels

JERGUSON GAGE & VALVE COMPANY
100 Adams Street, Burlington, Mass.
Offices in Major Cities
Bailey Meters & Controls, Ltd., London, Eng.
Controle Bailey, Paris, France

My biggest boner...

happened to someone else, back in the days before civil service and politics dictated hiring of state workers. I needed an assistant chief so I recommended two good prospects. But the high brass sent me a loyal party worker, their No. 3 buddy. Because he's still around this state, I'll call him Speedy. He started by telling us what a good engineer he was.

Speedy's first assignment was to hook up two feed pumps. He was to see that the assistants did the job correctly. After two days, Speedy reported everything OK, so I asked him to cut in the pumps. Few minutes later he phoned to say that the new pumps weren't up to specifications. They wouldn't pump against boiler pressure.

A check of the specs showed nothing was wrong so I called to ask him what the trouble was.

"Every time we turn on the pumps, the breakers trip," he reported. I called the electricians and told them to check the breaker and starter. They were OK. Then Speedy volunteered, "I'll make another test after lunch by just cracking the shutoff valve while cutting in."

"What about the checks," I asked, a little surprised. It was then that I learned he hadn't installed any. I had my hands full with other matters and thought it best to let him work out his simple problems.

Two hours later there was a loud BOOM from the powerhouse. Hurrying there, I found two helpers dead, three others badly scalded.

Speedy had put three of them to work shoving on a wrecking bar to shut the gate valve tight. With all that force, the seat ploughed through the valve's casting.

"This engineering work's too dangerous," complained Speedy, going for his hat and coat. That sure made me sad. I wonder how long these tragic boners are going to be pulled because of the low standards in many states?

L W FITZPATRICK
Jefferson City, Mo.

Adjustable blade pumps form the major portion of a $1,765,000 contract recently received by the S Morgan Smith Co of York, Pa., from the Department of Water Supply of the city of Detroit, Mich. Pumping units valves and accessories ordered will equip the city's new raw water booster pumping station at Water Works Park.

Pump Selection and Application

Just Published. How to size up pump requirements in a score of industries, how to understand pump performance, how to plan pumping installations for maximum economy of operation, and how to modernize existing installations, are some of the problems thoroughly treated in this book. **By Tyler Hicks, Special Projects Editor, Power. 432 pages, 411 illustrations, $8.50.**

Industrial Piping

Brings together a vast store of essential information on industrial piping. Covers steam, water, oil, gas, and instrument piping, giving useful methods of flow calculation. Tells which pipe materials, fittings, and valves should be used and explains methods of installing them. **By C. T. Littleton, formerly American Cyanamid Co. 394 pages, 170 illustrations, $9.00.**

Air Pollution Handbook

Just Published. A practical handbook offering much useful information for analyzing and solving air pollution problems. Discusses causes, effects, and controls in chapters covering the science of air pollution, effects on plants and animals, and various corrective techniques. **Edited by Magill, Holden, and Ackley, Stanford Research Inst. 670 pages, hundreds of illustrations, $15.00.**

Plant Operator's Manual

Gives quick answers to job problems — training in methods of good plant maintenance and operation. Covers scores of jobs on boilers, engines, turbines, pumps, compressors, condensers, valves, seals, and so on. **By Steve Elonka, Assoc. Editor, Power, 292 pages, 1539 illustrations, $5.00**

Announcing...

NEW McGRAW-HILL BOOK CATALOG

Just off press — 1957 catalog describes over 3000 books, all subjects, to help you advance, solve problems. Send 25¢ for mailing costs; catalog free. Check below.

FREE EXAMINATION COUPON

McGraw-Hill Book Co., Inc. Dept. P-3
327 W. 41st St., New York 36, N. Y.

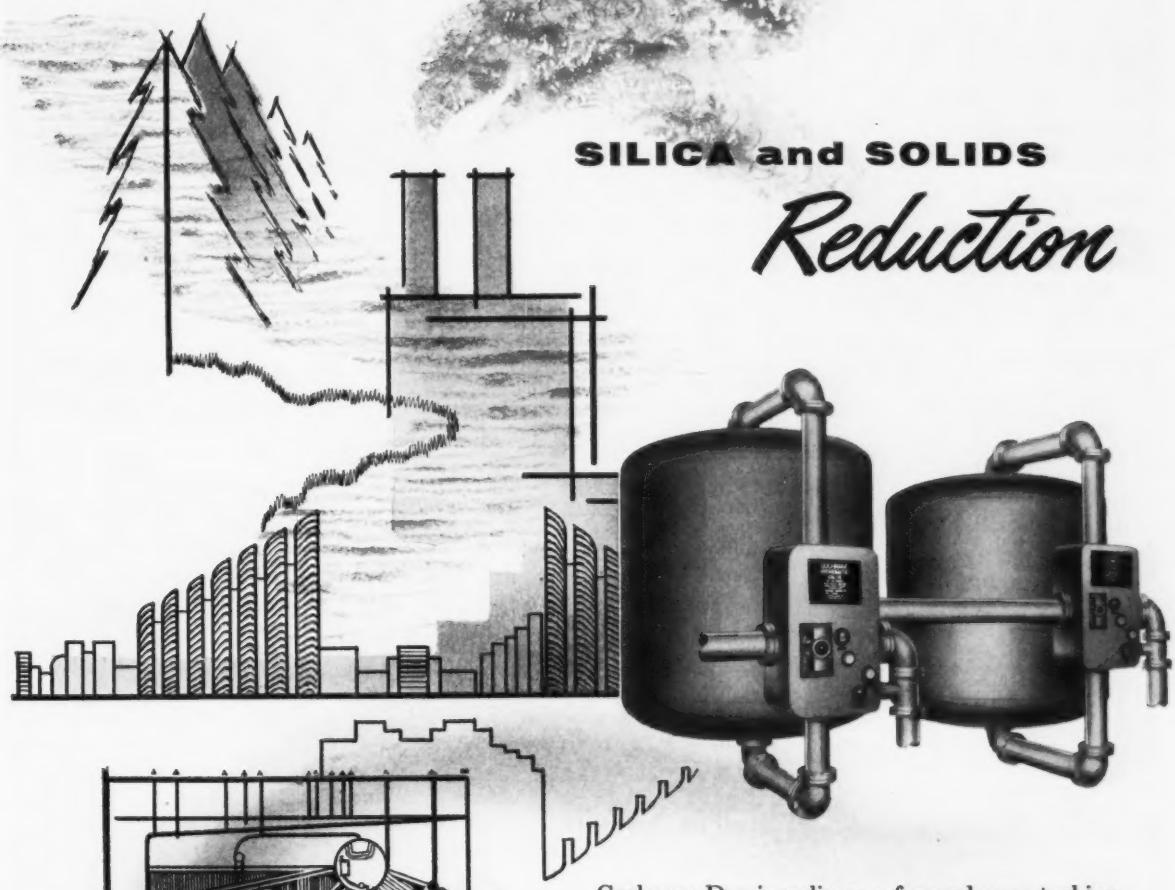
Send me the book(s) checked below for 10 days' examination on approval. In 10 days I will remit for book(s) I keep, plus few cents for delivery costs, and return unwanted book(s) postpaid. (We pay delivery costs, if you remit with this coupon—same return privilege.)

- ☐ Hicks—Pump Selec. & Oper., $8.50
- ☐ Littleton—Industrial Piping, $9.00
- ☐ Magill et al—Air Pollution Hdbk., $15.00
- ☐ Elonka—Plant Oprator' Manual—$5.00
- ☐ Send 1957 Catalog. I enclose 25¢

(PRINT)
Name .....
Address .....
City ..... Zone ..... State .....
Company .....
Position .....

For price and terms outside U.S. write McGraw-Hill Int'l. N.Y.C. P-3

COCHRANE . . . FIRST IN WATER CONDITIONING



SILICA and SOLIDS *Reduction*

Cochrane Demineralizers safeguard your turbine blades and high pressure boiler tubes. Their record of outstanding installations in scores of high pressure steam generating plants is proof of performance. The quality of demineralized water is superlative and Cochrane has an enviable record of progress in this field.

Cochrane Demineralizers now provide protection in oil refineries, paper mills, textile, chemical, aluminum producing and automobile manufacturing plants, and many other industries. These impressive installations of 2-bed, 3-bed, 4-bed and mixed-bed Demineralizers assure continuous, effective protection.

Why not check some of these installations (the list is available) then buy Cochrane Demineralizers for your new plant. Ask for Bulletin 5800-B.

Cochrane

CORPORATION

3106 N. 17TH STREET, PHILADELPHIA 32, PENNA.

NEW YORK • PHILADELPHIA • CHICAGO

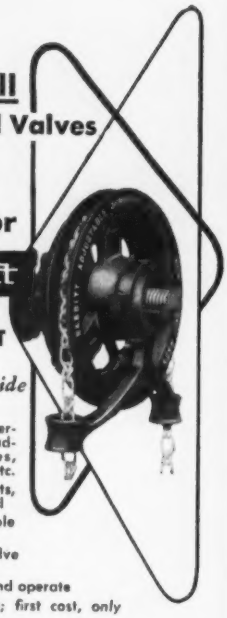
Cochrane Water Conditioning Ltd., Toronto 4; Montreal 1, Canada

Representatives in 30 principal cities in U.S.; Paris, France; La Spezia, Italy; Mexico City, Mexico; Havana, Cuba; Caracas, Venezuela; San Juan, Puerto Rico; Honolulu, Hawaii; Manila, Philippine Islands.

Pottstown Metal Prods. Div.—Custom built carbon steel and alloy products.

Demineralizers • Zeolite Softeners • Hot Process Softeners • Hot Lime Zeolite Softeners • Dealkalizers • Reactors • Deaerators • Pressure Filters Continuous Blowoff Systems • Condensate Return Systems • Steam Specialties

REACH All
Overhead Valves
without
DANGER!
REACH for



Babbitt
Adjustable
SPROCKET
RIM
with Chain Guide

- Eliminate dangerous catwalks, ladders, balconies, boxes, stools, etc.
- Prevent accidents, protect personnel
- Reach inaccessible areas easily
- Operate every valve from plant floor
- Easy to install and operate
- No maintenance; first cost, only cost
- Easy instructions with each unit
- Packed, completely assembled, one to a carton
- Fits any size valve wheel
- Your supplier carries complete stock
- Write for new descriptive Catalog sheet and prices:

Babbitt STEAM SPECIALTY CO.
2 BABBITT SQUARE, NEW BEDFORD, MASS., U.S.A.

The Greater the Pressure...
the Tighter It Holds!

WILCOX
Self-Sealing
GASKET

There's still nothing simpler or more efficient in power line service than this Wilcox Self-Sealing Gasket which has served industry so well over the years. The U-shaped metal outer cover is packed with a resilient filling (usually rubber or asbestos). Pressure exerted on this elastic filling forces it into the cover, putting force against the adjacent flange surfaces. Thus, internal pressure that tends to blow ordinary gaskets makes the Wilcox Gasket tighter in the joint. Available with covers of copper, lead, tin, aluminum, monel, stainless steel, etc. in all sizes—standard or special.

Write for details and quotations

CHICAGO-WILCOX MFG. CO.
7707 So. Avalon Ave.
Chicago 19, Ill.

AIR LEAKAGE

Continued from page 115

metric pressure to standard barometric pressure (30-in. Hg abs).

Ambient air temperature affects rate of air leakage. For temperatures other than 70 F, multiply by the square root of the ratio of 530 R to actual air ambient air abs temperature.

Orifice selection is made from the table on page 115. Orifice sizes, listed for various system volumes, produce a pressure rise of 5-in. Hg abs in about 10 min. This is long enough for easy observation of pressure change. To use table, estimate size of system volume, then select matching orifice size.

For best results use an orifice with a well-rounded inlet equal in proportion to the ASME long-radius flow nozzle or HEI standard flow nozzle. These types have the least variation in flow coefficients and can be improvised on with reasonable accuracy. For Case B take a ¾- or 1-in. pipe plug and drill the orifice through the center. Then machine a well-rounded inlet on the upstream side. Use care when installing to avoid altering shape or size of the orifice. If it is drilled oversize, adjust air flow by multiplying air flow figure from table by square of the ratio of actual orifice dia to tabular dia.

TURBOCHARGING

Continued from page 99

engine; resulting greater density increases cylinder charge.

Performance. Series turbocharging nearly doubles specific output of unsupercharged 2-cycle engines of nine years ago and yields a nearly 40% increase on more recent designs. Fuel economies as low as 6900 Btu per bhphr can now be guaranteed for larger engines. No capacity derating is required for altitudes up to 7500 ft.

TURBOCOOLING

The advantages of cooler intake air for internal-combustion engines are well known. One big factor, of course, is that greater air density permits more weight of air to be charged into a given cylinder volume at a given pressure. Cooler air is particularly helpful for gas engines: it improves flame propagation and reduces tendency to detonate. Resulting smoother combustion means lower peak pressures with reduced mechanical and thermal loadings and quieter engine operation.

Turbocooler unit. Use of aftercoolers is now common practice on supercharged engines. Extent of cooling possible depends on temperature of water available for use in the aftercooler. But air can also be cooled by expan-

IF YOU BUY
OR SPECIFY
CONTROLS

MERCOID®
CATALOG No. 857

Will help make
your selection easier

WRITE FOR YOUR
FREE COPY

CONTENTS:

CONTROLS FOR
PRESSURE—
DIFFERENTIAL PRESSURE—
TWO-STAGE PRESSURE—
TEMPERATURE—
TWO-STAGE TEMPERATURE
LIQUID LEVEL
FLOAT OPERATION
LEVER ARM OPERATION

CASE STYLES
TO MEET VARIOUS
REQUIREMENTS
INDOOR
(General Purpose)
OUTDOOR
(Weather Resistant)
HAZARDOUS LOCATIONS
(Explosion-proof)

ALL MERCOID CONTROLS
INCORPORATE SEALED
MERCURY CONTACTS

ASK FOR CATALOG
NO. 857-P

THE MERCOID CORPORATION
4201 Belmont Ave., Chicago 41, Ill.

Why MORE and MORE people are specifying

J&L PRESSURE TUBING

J&L electric resistance welded pressure tubing can easily be fabricated according to your requirements. Fabrication costs are minimized.

Most modern testing procedures assure maximum strength and safety standards. J&L, an integrated steelmaker, controls every step of production from iron ore to finished tubing. The J&L stencil on pressure tubing is our guarantee that every safeguard possible has been used to assure top quality for you.

Specify Jones & Laughlin pressure tubing for quick delivery, long life and maximum strength. For name of your nearest source, write to the Jones & Laughlin Steel Corporation, Dept. 511, 3 Gateway Center, Pittsburgh 30, Pennsylvania

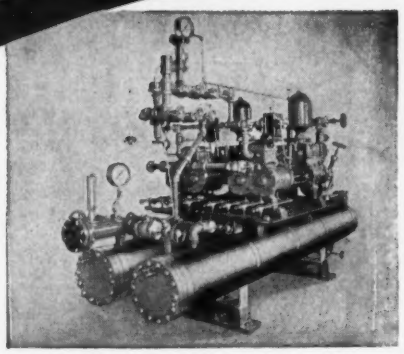
J&L STEEL

Jones & Laughlin

... a great name in steel

Enco Automatic
OIL PUMPING
AND HEATING SYSTEM

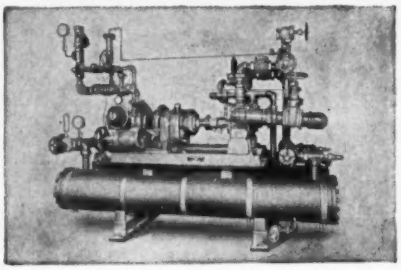
Completly Coordinated



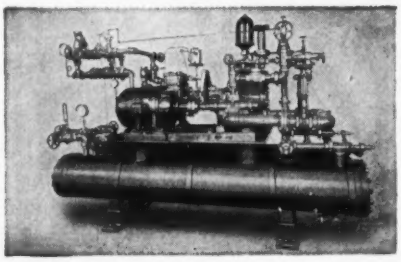
Two Horizontal Duplex Piston Type Steam Pumps and two fuel oil heaters—capacity 15 G. P. M. at 250 lb. pressure with either pump or heater.

Every detail part of an Enco Automatic Oil-Heating-and-Pumping Unit System is designed, assembled, checked and tested to make sure that it functions as an element of a completely coordinated unit. The sizes of pipes, fittings, valves and other elements are correctly proportioned for the efficient, dependable operation of the unit as a whole. All hand controls are visible and within reach of the operator for quick starting, stopping or cross-over reconnections between duplicate heaters and pumps. Adjustments and cleaning are similarly simplified.

Single or duplicate heaters and electric or steam-driven pumps are used. Interconnected duplicate units give full capacity with either pump or either heater. Capacities range from 100 to 5000 G. P. H. of heavy bunker oil.



One Turbine and One Motor Driven Pump and two fuel oil heaters. Capacity 30 G. P. M. at 150 lb. pressure with either pump or heater.



One Horizontal Duplex Piston Type Steam Pump and one Motor Driven Pump and two fuel oil heaters. Capacity 20 G. P. M. at 300 lb. pressure with either pump or heater.

BULLETINS ON REQUEST

OB-53 On oil burning, pumping and heating equipment.

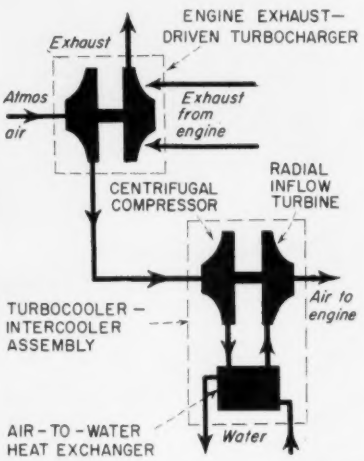
OB-38 Instruction book on care and operation of oil-burner installations.

THE ENGINEER COMPANY
75 WEST STREET Enco NEW YORK 6, N.Y.

TURBOCHARGING

Continued from page 226

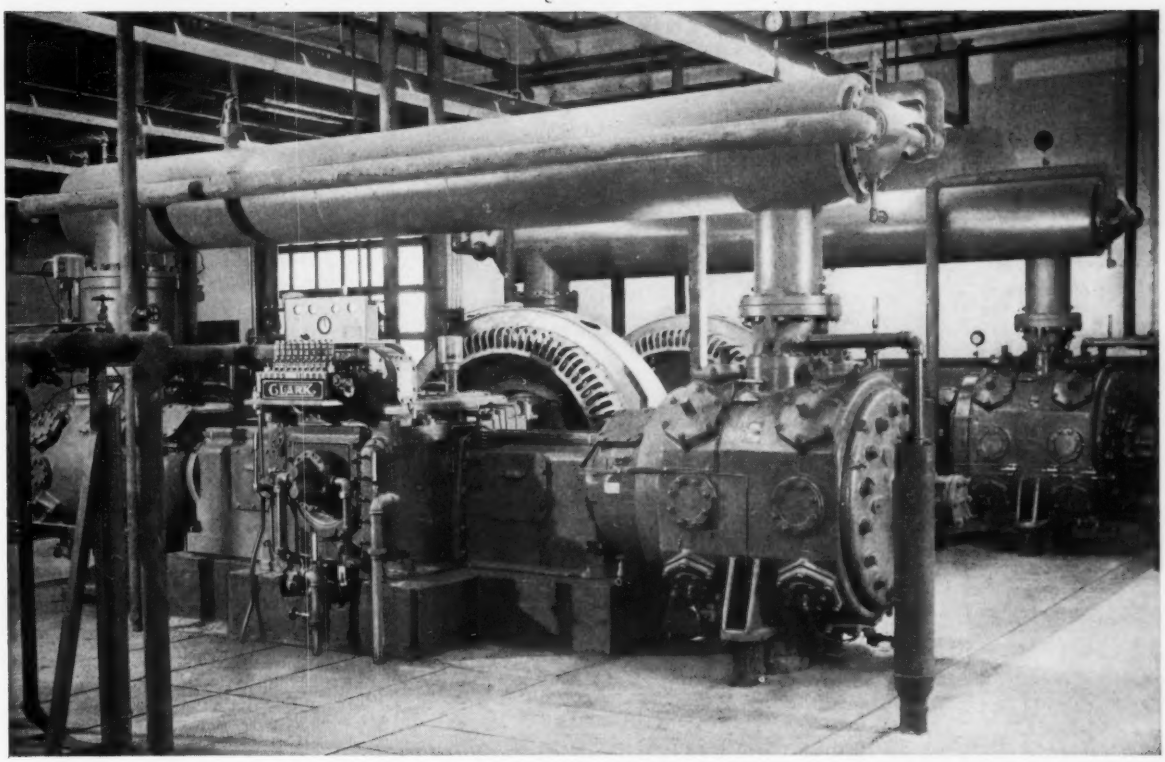
sion. That's the principle of the turbocooling system diagrammed below. Filtered combustion air enters a high-pressure turbocharger in the usual way. The turbocharger discharges air at higher temperature and pressure to the centrifugal compressor section of the



TURBOCOOLING arrangement yields air at temperatures in neighborhood of 60 F

turbocooler. Here the air undergoes a second stage of compression, reaching still higher temperature and pressure levels. If ambient air is 90 F, temperature out of turbocharger would be 195 F and out of centrifugal compressor would be 230 F. Air then enters an air-to-water heat exchanger, which drops temperature to 100 F. At this temperature, and at high pressure, air then expands in a radial inflow turbine to the required manifold pressure. It gives up energy, providing power to drive the centrifugal compressor, and is cooled in the process. For the assumed conditions, air would go to the engine at 60 F.

Because of the higher pressure and temperature entering the air-to-water heat exchanger, more heat can be transferred to the cooling water than would be possible with normal aftercooling following a single stage of compression. And the final temperature reached is lower than normally obtainable in a straight water-cooling operation. Thus turbocooling, as developed by Cooper-Bessemer engineers, offers the lower temperatures desirable for gas engines, with a large measure of independence from cooling-water temperature limitations. Comparisons on the same engine, with an aftercooler in one case and a turbocooler in the other, show better fuel economy over the entire load range with turbocooling.



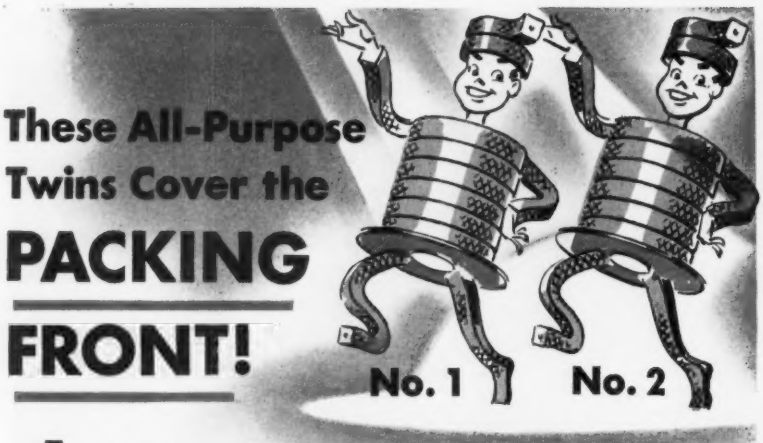
What Jules Verne couldn't foresee!

Around the world, 24,325 miles of it, in 45 hours and 19 minutes... our strategic B-52 bombers did it non-stop! This speedy trip made Jules Verne's "80 days" seem like a lifetime. Part of the B-52 — the electrical pneumatic units that drive generators to provide the muscle for operating flaps, gun turrets, radar and countless other operations are provided by Thompson Products, Inc. of Cleveland, Ohio. Four of these 205 horsepower units go into every B-52. To be certain they are perfect, Thompson gives them a thorough test before shipment. One 350 horsepower Clark CMA-4 and two Clark 600 horsepower CRA-2 air compressors furnish the air for testing.

There is a vibrationless Clark balanced/opposed compressor for practically every requirement. Sizes range up to 6000 horsepower. Your nearest Clark representative has all the facts.

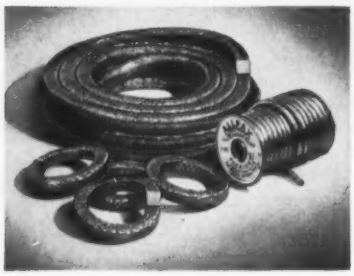
CLARK BROS. CO. OLEAN, NEW YORK
One of the Dresser Industries
Offices in Principal Cities Throughout the World

CLARK **Balanced/Opposed Compressors**



These two styles of Allpax Packing cover a wide range of applications and many different uses, consistent with the policy of our company—fewer packings for more services.

Both are compounded of the highest quality materials, and between them they cover against such service conditions as steam, water, air, ammonia, gases, oils, distillates, dowtherm, etc. They are for use on centrifugal and rotary pumps, valve stems, expansion joints and similar equipment.



Packaged in durable metal containers to insure protection and preservation of material. Applications and uses conveniently noted on each container.

Style No. 1 is really universal in its uses—where the temperature does not exceed 600 degrees F.

Style No. 2 also has an extremely wide variety of uses in higher temperatures, ranging from 600 degrees F. to 1200 degrees F. This is because of a special bonding compound, containing a heat-proof lubricant, which maintains the lubricant under high temperature conditions.

Both types are made in ring, spool or coil form in a wide variety of sizes. Allpax Packings do a better job for manufacturers and replacement use because they are precision-made, accurate in dimensions. They provide a tight seal without danger of scoring or unnecessary wear.

ALLPAX

"The Packing that Packs All"

SEND FOR OUR NEW CATALOG — TODAY!

A complete line of packing, tools, gasket materials.
Distributors in principal cities.

THE ALLPAX COMPANY, INC.
160 Jefferson Ave., Mamaroneck, N. Y.
CANADIAN DISTRIBUTORS: Albion Asbestos Packings Ltd., Montreal 8, Quebec

COMBAT CORROSION

Continued from page 117

recirculating water. If index is positive, water tends to deposit scale on heat-transfer surfaces. If index is negative, corrosion will occur and any previously deposited scale will tend to go back into solution. Inhibit corrosion by maintaining a slightly positive index (0.6 to 1.0) to insure definite scale deposition on heat-exchange surfaces. When properly handled, "controlled scale" method will give excellent results.

Index of the recirculating stream can be adjusted by treating the makeup water. Equipment is manufactured to remove hardness, reduce alkalinity and remove total dissolved solids from any given water supply. Look into these treatment methods for your system: (1) zeolite softening (2) zeolite softening plus acid feed (3) blend of zeolite-softened and hard water (4) hydrogen zeolite plus caustic feed (5) cold lime-soda softening (6) H & Na dealkalizer (7) salt regenerated anion dealkalizer preceded by zeolite softening (8) demineralization.

Make use of the many special chemicals available for scale and corrosion protection. With above treatment methods they frequently broaden the control range of the Langelier index. Often they can handle the complete treatment alone. In either case their use is called for on most jobs.

Metaphosphates are used for "threshold" treatment of water. Concentrations used are far too low to combine with the calcium present. But they do prevent scale, hold iron in solution and prevent corrosion. Main circulating-water systems use this treatment with considerable success. It functions best at a pH below 7.0. Cost is intermediate between chromates and the alkaline salts used in the "controlled scale" method.

Chromates. Keep a zero or negative index for this treatment since formation of scale for corrosion protection is not required. Chromate forms a film of ferrous and chromate hydroxide which acts as a physical dam preventing metal and water contact. About 300 to 500 ppm is sufficient for most systems. Protection is obtained at lower dosages if metaphosphate in small amount is fed with the chromate.

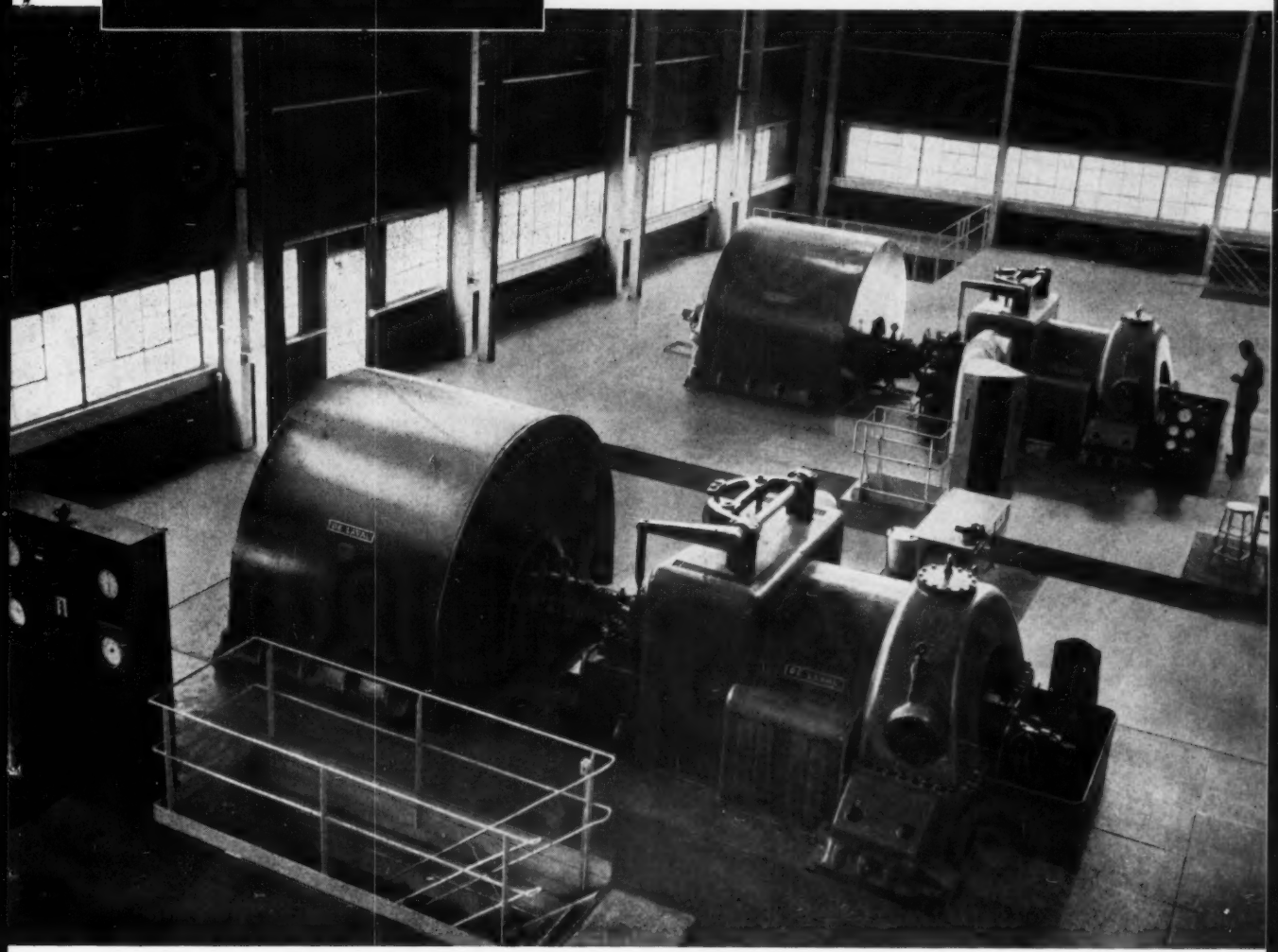
Organic compounds are being used with increasing frequency. They often contain chromates and alkalies in addition to organic material. Advantages claimed for these chemicals include: (1) ease of control (2) simplified handling since material is not toxic like the chromates. Main disadvantage seems to be the relatively high cost, especially for systems with high makeup.

(*Continued on page* 232)

DE LAVAL

BLAST FURNACE BLOWERS

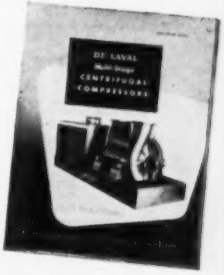
deliver 110,000 cfm each for McLouth Steel



These two De Laval turbine-driven centrifugal blowers do a round-the-clock job in the McLouth Steel plant, Trenton, Michigan. Each has a rated capacity of 110,000 cfm of air; discharge pressure is 30 psig. Each is driven by a 12,400 hp, 2950 rpm De Laval steam turbine operating under steam conditions of 600 psig, 825 F with 2″ hg.

De Laval compressors are designed individually for each application to assure maximum efficiency and range of operation. Construction is rugged throughout. Casings and perfectly balanced rotors are built to take punishment. All parts are precision-made to limit gages. Materials are selected which will best meet the particular conditions of corrosion, pressure and temperature.

De Laval centrifugal blowers are built in single and multi-stage types to supply air in volumes up to 150,000 cfm for all classes of service in steel, gas and coke plants. The wealth of application experience acquired by De Laval over the years assures a correct and economical solution to your blower problem.



Send for Bulletin 0504

DE LAVAL *Centrifugal Blowers*

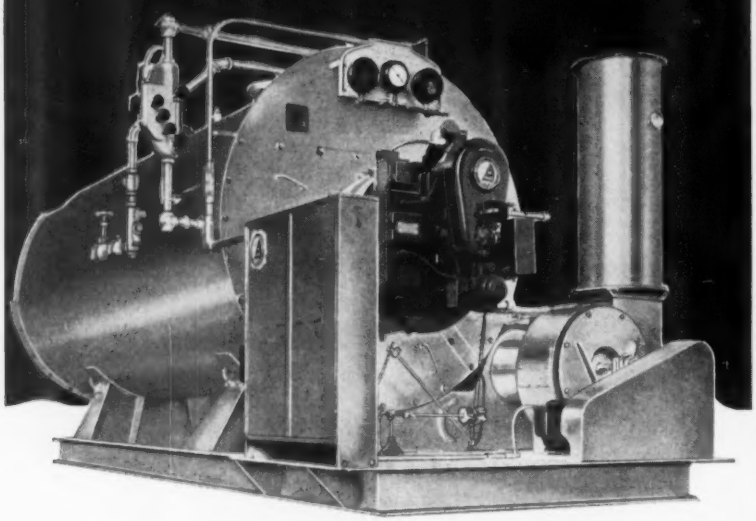
DE LAVAL STEAM TURBINE COMPANY

815 Nottingham Way, Trenton 2, New Jersey

DL 360

Preferred

BY THOSE WHO KNOW
—AND WILL PAY MORE



Distinguished beyond all others!

The Preferred Unit Steam Generator has long stood so completely apart in general performance and life expectancy that every year sees its leadership lengthened and strengthened.

This unique "package" boiler is designed to meet the particular steam producing requirements of a particular group of owners. They are the proud Preferred users who realize that the basic quality of a unit steam generator lies in the care and attention that go into the development and design of every detail.

Such painstaking care assures those who pay more initially that they will receive premium performance over more years, lower operating and maintenance costs, freedom from failures of major components—hence, lower eventual cost.

Catalog No. 2000 is a complete manual of basic considerations of fine boiler design and of the many exclusive features incorporated in the *Preferred* Unit Steam Generator.

PREFERRED UTILITIES MFG. CORP.

1860 BROADWAY Dept. PW NEW YORK 23, N. Y.

COMBAT CORROSION

Continued from page 230

Chlorine, copper sulfate, phenolic and quaternary ammonium compounds have been successfully used for control of slime and organic matter in recirculation systems. Exact chemical selected depends on the pH maintained in the circulating stream and the type of organisms present.

Once-through systems are usually given a limited form of treatment because of the tremendous flow rates involved. Remove turbidity, if necessary, by clarification and/or filtration. Then use Langelier index as a guide and adjust the pH with acid or alkali. Metaphosphates are also used successfully to prevent scale and corrosion.

Hydrazine Conference

Hydrazine as a deoxygenerator for boiler water will be the subject of a forthcoming conference to be held at Bournemouth, England.

The conference, which will run from May 15th to 17th, is being held because of the interest shown in hydrazine during recent years. Second motivation for conference is the hope of spreading as much information as possible about this use and application of hydrazine.

Delegates and lecturers from the United Kingdom, Europe and America have been invited to attend and discuss their experiences with hydrazine in detail.

Papers and subsequent discussions will be published in book form after conference and will be available to interested persons.

Address requests for the registration form and provisional agenda to Whiffen and Sons Ltd, NW House, Marylebone Rd, London, NW 1, England.

"Whatta you mean—eeny, meeny, miney, mo?"

Low Cost COAL CRUSHING

with American ROLLING RING COAL CRUSHER

In 18 months, this American Rolling Ring Crusher reduced 1,162,572 tons of 6″ x 1½″ bituminous coal to a minus 2″ product.

Total cost of replacement parts was less than 1/30th of a cent per ton of coal.

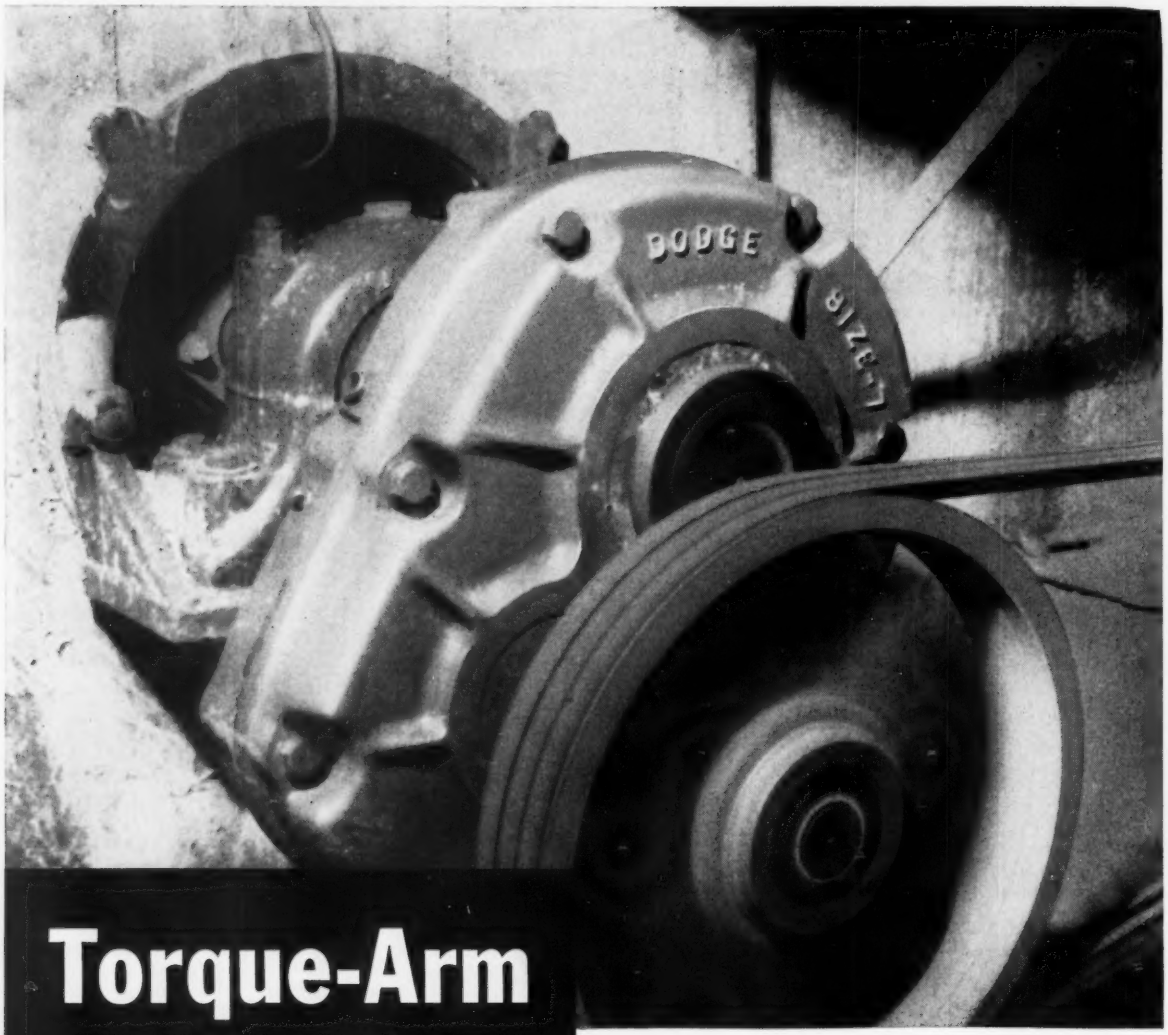
Write for descriptive bulletin on American AC Coal Crushers.

"When you figure Costs— the best results come from American Rolling Ring Crushers."

American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

1349 Macklind Avenue • St. Louis, Mo.

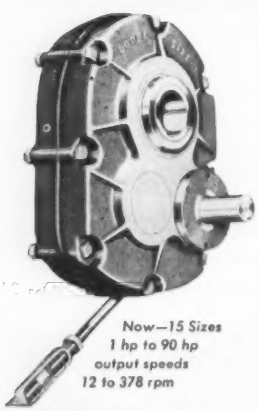


Torque-Arm

SHAFT-MOUNTED SPEED REDUCERS

Size 7 Torque-Arm Speed Reducer on agitator in paper mill

Save Up to 1/3 in Installation —Deliver 97% Efficiency!



Now—15 Sizes
1 hp to 90 hp
output speeds
12 to 378 rpm

Easy to install! Mounted directly on the driven shaft. Locked at both ends. Dodge Torque-Arm Speed Reducer requires no foundation, no flexible coupling, no sliding base, and there's no lining-up problem. Amazing economy is matched by efficiency in operation—up to 97%.

Unit is driven through V-belt drive. Stock Taper-Lock Sheaves prescribed for each job permit speed ratios required. Tri-Matic Overload Release and backstop available, if desired. Dodge Torque-Arm is America's most complete line of shaft-mounted Speed Reducers. Ask your Dodge Distributor—or write us.

CALL THE TRANSMISSIONEER, your local Dodge Distributor. Factory trained by Dodge, he can give you valuable assistance on new methods. Look for his name under "Power Transmission Machinery" in the yellow pages of your phone book—or write us.

•

DODGE MANUFACTURING CORPORATION
3200 Union Street, Mishawaka, Indiana

DODGE
of Mishawaka, Ind.

ENGINEERS' BOOKSHELF

Electric Utility Library, 4 Vols. *Edited by B G A Skrotzki, Engineering and Management Editor,* POWER, *staff of 13 contributors, $27. McGraw-Hill Book Co, 330 W 42 St, New York 36, N. Y.*

Electric Generation — Steam Stations. *6¼ x 9¼, 454 pp, illust, tables, $8.50.*

For technical workers in the electric utility industry and related activities, this book gives concise descriptions of the construction, operation and theory of principal equipment in modern central steam-electric stations. Chapters cover: fuel supply and analysis; plant fuel- and ash-handling systems; steam generators; piping; steam turbines; condensers; condensate and feedwater systems; water treatment; station control; electric generation; station electric circuits; station auxiliary drives; superpressure stations.

Electric Generation—Hydro, Diesel, and Gas-Turbine Stations. *6¼ x 9¼, 458 pp, $8.50.*

Like other books in this series, this one aims to acquaint nonprofessional technical people with the equipment and operation of the stations mentioned in its title. Chapters cover: water power; dams and hydraulic structures; water turbines; generators and switching; hydroelectric stations; internal-combustion engines; i-c engine power plants; gas turbines.

Electric Transmission and Distribution. *6¼ x 9¼, 448 pp, illust, tables, $7.50.*

Starting with basic electricity, this book outlines the theory and application of the transmission of electric power from generating station to consumer. It is also written for the nonprofessional technical man in the utility field. Chapters cover: electric theory; transmission terminal facilities; transmission lines; distribution systems—mechanical; distribution systems—primary and secondary; distribution systems—capacitors and transformers; distribution systems—protection; street lighting; planning and load characteristics; auxiliaries.

Electric System Operation. *6¼ x 9¼, illust, tables, 370 pp, $6.50.*

Here the technical man learns the methods of operating the complete electric utility system. While other volumes give details on major and auxiliary equipment, this book covers the controls and methods of running a system as an efficient, integrated unit. Chapters include: the system; relays; load dispatching; frequency and load control; system communications; station performance; economy loading; system operating costs; rate schedules.

Industrial Engineering Handbook. *By Harold B Maynard, Editor-in-Chief. 1054 pp, 648 illust, $17.50. McGraw-Hill Book Co, 330 W 42nd St, New York 36, N. Y.*

A broad, authoritative treatment of the whole field of industrial engineering is made available in this handbook of principles, data, methods and procedures. Experts in the field have contributed a measure of their experience on such topics as the industrial engineering function, work measurement, predetermined elemental time standards, wage payments, plant facilities and design, and control procedures.

Factual and how-to-do-it in approach, the book covers many practices, from such long-accepted techniques as time and motion study to such developments as automation and linear programming. Both procedures used directly by the industrial engineer, and such related ones as quality control and tool and gage design, are covered. Human and industrial relations of industrial engineering are stressed throughout the book.

Nuclear Energy in Industry. *By J G Crowther. 8¾ x 5¾, 168 pp, 100 illust, 11 tables, $3.95. Pitman Publishing Corp, 2 W 45th St, New York 36, N. Y.*

Here is a layman's summary of the papers presented at the 1955 International Conference on the Peaceful Uses of Atomic Energy held at Geneva, Switzerland. The author emphasizes, largely, the position of the UK in the potentialities of atomic energy. After a brief look at the world energy supply and demand, he takes a quick look at the activity and history of developing nuclear theory. He then surveys the types of reactors proposed and projected and looks in detail at power reactor plants.

Toward the end of the book, he reviews the practical uses of radioisotopes in industry. One chapter describes the discovery and mining of uranium in an interesting, essentially nontechnical fashion. The book closes with a discussion of the newer metallurgical processes and technology that has been developed to handle nuclear fuels and wastes.

Thermal Power from Nuclear Reactors. *By A Stanley Thompson, chief engineer Nuclear Power Department, Studebaker-Packard Corp, and Oliver E Rodgers, assistant general manager, Government and Industrial Products Division, Studebaker-Packard Corp. 9¼ x 6¼, 229 pp, illust, $7.25. John Wiley & Sons, Inc, 440 4th Ave, New York 16, N. Y.*

By making liberal use of advanced mathematics the authors point up the special design problems met in laying out power reactors as contrasted with conventional thermal power plant equipment. Rather than rely on extended theoretical discussion of the nuclear fission process and chain reactions, the authors show how reactor engineering should be performed based on the data found from many empirical experiments. This book does not review the methods by which the basic design data was obtained. The reader is referred to other books and papers for descriptions of these methods.

The book emphasizes the new analysis methods for reactor design, especially in

FLEXIDYNE
THE DRY FLUID DRIVE
100% efficiency at full load!

DODGE-TIMKEN
America's Quality Pillow Blocks!

SEALED-LIFE V-BELTS
The life is sealed in!

•

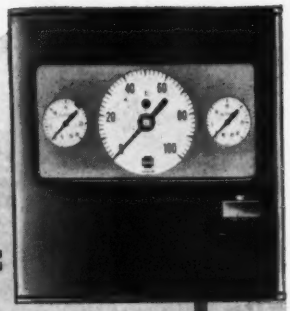
Write for Bulletins!

- Flexidyne Dry Fluid Drives and Couplings. Bulletin A-640-A.
- Roller Bearings. Load ratings, dimensions, etc. Bulletin A-638.
- Sealed-Life V-Belts. Complete data and sizes. Bulletin A-644.

DODGE MANUFACTURING CORPORATION
3200 Union Street • Mishawaka, Indiana

DODGE
of Mishawaka, Ind

From
TRANSMITTER
to
RECEIVER GAUGE



unequalled USG®
sensitivity-dependability

There's never a question as to the accuracy of temperature or pressure readings when transmitted by USG Pneumatic Transmitters.

And for accurate reception of signals from remote points, there's nothing to match the sensitivity of the new USG Receiver Gauge.

Consider these features:

USG PNEUMATIC TRANSMITTERS

- Sensitivity—Within 0.1% of full scale.
- Accuracy—1% (indicating) or ½% (non-indicating)
- Designed to operate at remote points for long periods without attention. High sensitivity, linearity and freedom from dead spot assure the ultimate in control stability.

USG PNEUMATIC RECEIVER GAUGES

- Sensitivity—Within 1/10 of 1% of full scale.
- Accuracy—± ¼ of 1% of full scale.
- Diaphragms made of Ni-Span "C", a special high nickel alloy with a minimum thermal shift, even under wide variations in ambient temperature.
- Available in 3½", 4½", 6" and 8½" sizes.
- Also available are 2", 2½" and 3½" Bourdon tube actuated type receiver gauges.

USG Transmitters and Receiver Gauges are part of USG's line of creatively engineered process control instruments. The line includes gauges, pressure and temperature pilots, recorders and controllers. Write for catalogs.

Find Your Nearest Distributor in the 'Yellow Pages'

USG
UNITED STATES GAUGE
Division of American Machine and Metals, Inc.
Sellersville, Pa.
Home of the SUPERGAUGE

MORE THAN 50,000 TYPES OF GAUGES • SUPERGAUGES • SOLID FRONT GAUGES • RECEIVER GAUGES • TEST GAUGES • RECORDERS • CONTROLLERS • TRANSMITTERS • PSYCHROMETERS • AVIATION INSTRUMENTS

More BOOKSHELF

Begins on page 235

the area of neutron distribution, criticality and reactor kinetics. The authors believe they offer new viewpoints in handling design problems by numerical methods, dimensional analysis and nonlinear kinetics of reactor behavior.

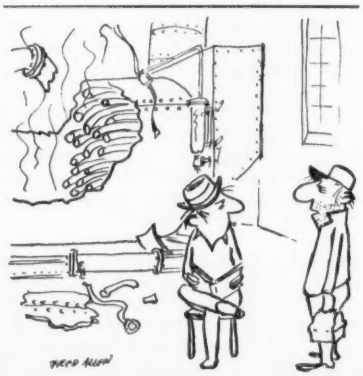
Chapter headings include: nuclear considerations, reactor equations and critical mass, reactor kinetics, shielding of reactors, reactor materials, thermal stress, power extraction from reactors, and thermal power cycles.

Principles of Turbomachinery. *By D G Shepherd, professor of Mechanical Engineering, Cornell University. 6¼ x 9, illust, tables, 463 pp, $10. The Macmillan Co, 60 5th Ave, New York 11, N. Y.*

Fans, compressors, pumps, steam turbines, gas turbines and hydraulic turbines are all related closely through the principles of transferring energy between a fluid and a rotor. This book discusses the theories of all these turbomachines and shows how they are related. It assumes the reader has a grounding in engineering thermodynamics and fluid dynamics. To aid understanding and jog memories, the basic principles are introduced and briefly discussed before their applications to the turbomachinery are shown.

The book first covers a general treatment of all forms of turbomachinery through dimensional analysis, energy transfer, thermodynamics of compressible flow and the flow of fluids through passages and over blades. The author then applies these principles to the several kinds of machinery, in enough detail to demonstrate the major design and performance factors. Most of the usual design methods are discussed and exemplified. This gives the student some familiarity with the ideas and analysis methods used in design.

Mechanical design limitations are only touched upon where they influence the energy transfer performance of a machine. The author argues that machine design should also be taught on a unified basis for all forms of machinery and not be stressed in a book such as this. Turbomachinery should be in the libraries of all mechanical engineers concerned with this type of equipment.



"Anything new?"

NUCLEAR NEWS FROM ATOMICS INTERNATIONAL

OMR a promising approach to meet world's need for small to large power plants

An important goal of the Atomic Energy Commission's program to develop electric power from the atom is a low-cost reactor for plants with gross outputs of 10 megawatts or more. Such plants are particularly suited to areas that need relatively small increments of additional power, and to those parts of the world where coal, oil, and water-power are scarce or costly.

The OMRE (Organic Moderated Reactor Experiment), which ATOMICS INTERNATIONAL is now building at the National Reactor Testing Station in Idaho, is one of the more promising types for this purpose. The new experimental reactor was pioneered by ATOMICS INTERNATIONAL – from preliminary design to prototype.

It will be used to investigate the rate of degradation of organic fluids, the properties and compositions of the equilibrium mixture in the reactor, and the effect of organic fluids on heat-transfer surfaces. Results of these experiments will be incorporated into the nuclear power plants ATOMICS INTERNATIONAL is planning for Piqua, Ohio and a Latin American country.

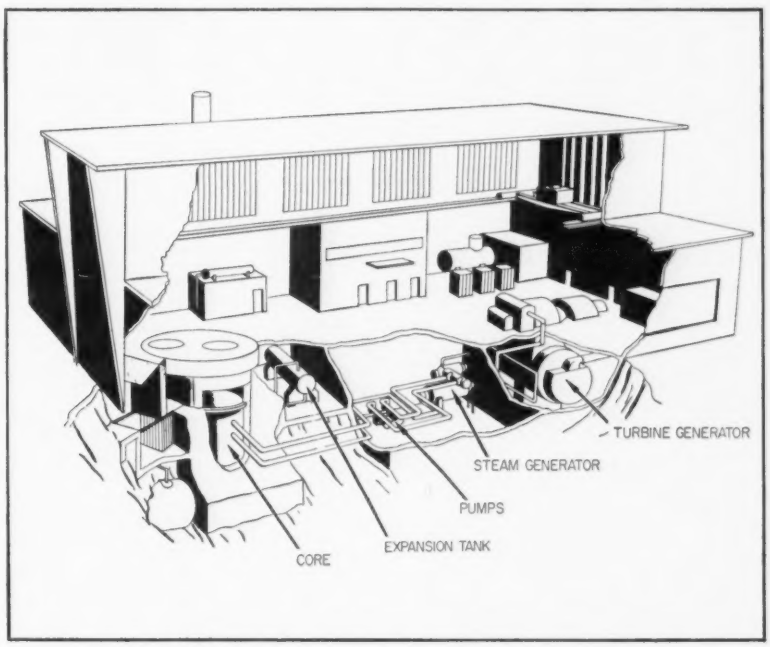
Basic advantages of the OMR are small size, compact core with good neutron economy, and elimination of problems with high-pressure primary coolant circuits and uranium-coolant reaction hazards. Its safety features are outstanding. The high boiling point of the organic moderator-coolant fluid permits a low-pressure system. There are no chemical incompatibilities between coolant and uranium or coolant and water, and no unusual corrosion problems. Because of its fluid moderator—an isomeric terphenyl—the OMR has a negative temperature coefficient of reactivity, which acts as a governor in case of power surges or excess power levels. The organic fluid becomes only slightly radioactive, which makes the entire heat-transfer system relatively accessible.

A typical power plant, such as the one proposed for Piqua, Ohio, has a gross electric output of 12,500 kilowatts and a heat output of 45,500 thermal kilowatts. It produces steam at a pressure of 415 psig (29 kg/cm^2) and a temperature of 550°F (288°C).

The reactor core is heterogeneous, with fuel elements and control rods immersed in the moderator-coolant fluid and contained in a thin-walled core tank. The fuel is uranium slightly enriched in U^{235}.

Power costs for this reactor, including both capital and operating charges, are estimated at 18 mills per kilowatt-hour. Power costs will be significantly lower in larger OMR plants. Lower power costs are also expected to result from advances in OMR technology.

Atomic power for supertankers. The AEC has assigned ATOMICS INTERNATIONAL the challenging design study to adapt the OMR for maritime use. The OMR, considered a promising possibility for ship propulsion, is expected to be particularly suitable for supertankers. The OMR offers the safety of a low-pressure system, low construction costs (because it can be built of aluminum and mild steel instead of more expensive zirconium and stainless steel), and low maintenance costs.



Typical OMR Central Station Nuclear Power Plant

ATOMICS INTERNATIONAL is staffed and equipped to help you with any phase of reactor development. Please write: Director of Technical Sales, Dept. PW-72, ATOMICS INTERNATIONAL, P. O. Box 309, Canoga Park, California. Cable address: ATOMICS.

ATOMICS INTERNATIONAL
A DIVISION OF NORTH AMERICAN AVIATION, INC.
PIONEERS IN THE CREATIVE USE OF THE ATOM

Clean Oil

SAVES YOU MONEY!

HILCO

OIL MAINTENANCE EQUIPMENT

. . Keeps your Oil and Equipment Clean

FILTER

Furnished in capacities from 0.1 to 750 gpm. Various cartridges available for mineral and inhibited detergent oils.

HILCO FILTER CARTRIDGES

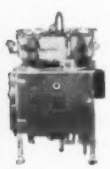
The result of much research in the field of lubricating, fuel and industrial oil filtration, the new patented HILCO Filter Cartridges meet the need for tremendous filtering area, low pressure drop and high dirt storage capacity. Above: Fig. 1 is a new cartridge; Fig. 2 is a used cartridge (note that pockets are completely filled and the outer surface covered with solids); Fig. 3 shows the flow of oil, the dark area represents dirty oil passing into the pockets while filtered oil (white area) passes into "S" shaped section.

HILCO Purification Means *Complete* Oil Purification . . .

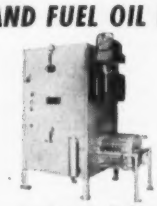
You get absolute removal of sludge, acids, carbon, water and fuel dilution with a properly selected HILCO. Clean oil saves you money. Expensive maintenance is reduced, equipment shut-downs practically eliminated, lost man hours and cuts in production become a thing of the past. HILCO continuous, all electric, automatic purification keeps your oil clean and in top condition at all times. You receive the full capacity and economy of your equipment.

HILCO offers a wide range of oil purification units to meet every oil conditioning problem. HILCO units are manufactured in both stationary and portable models. Write us about your purification needs . . . recommendations are given with no obligation. Let HILCO put its 25 years of experience in oil purification to work for you.

THERE'S A HILCO FOR EVERY LUBRICATION AND FUEL OIL FILTERING PROBLEM



Oil Reclaimer



Purifier Re-Refiner

High Capacity Reclaimer

WRITE TODAY FOR THE NEW HILCO CATALOG

• Recommendations at no obligation!!

THE HILLIARD Corporation

159 W. FOURTH ST. • ELMIRA, NEW YORK

IN CANADA: Upton-Bradeen-James Ltd., 890 Yonge St., Toronto; 3464 Park Ave., Montreal

REPORTS from the FIELD

Begins on page 154

Sterling Forest *continued*

of industry, now bidding for space in the project.

Major facilities on the Union Carbide site will include: a 5-mw pool-type reactor, a radioactive materials laboratory, an ores and engineering lab and a building for allied research and administrative functions.

Research programs will be geared to the study of radiation effects on products and processes involving plastics, gases, metals, carbons and chemicals.

Two-thirds of the reactor building will be carved out of a solid granite mountain.

According to Morse G Dial, President of Union Carbide, completion of the research center is scheduled for late 1958 or early 1959. Initially some 150 persons, including scientists, engineers and metallurgists will be employed in the center.

Reynolds Metals discloses plans for plant on St. Lawrence system

► FOLLOWING Governor Harriman's approval of the Reynolds Metals Contract for St. Lawrence Power, J Louis Reynolds, Executive Vice President, Reynolds Metals Co, issued the following statement:

"There is no question in our mind that our primary aluminum plant near Massena, New York, will prove mutually beneficial to Reynolds and the people of the State of New York.

The announcement by General Motors of its intention to build an aluminum foundry near our plant is immediate evidence of the economic advantages the state will derive from our project.

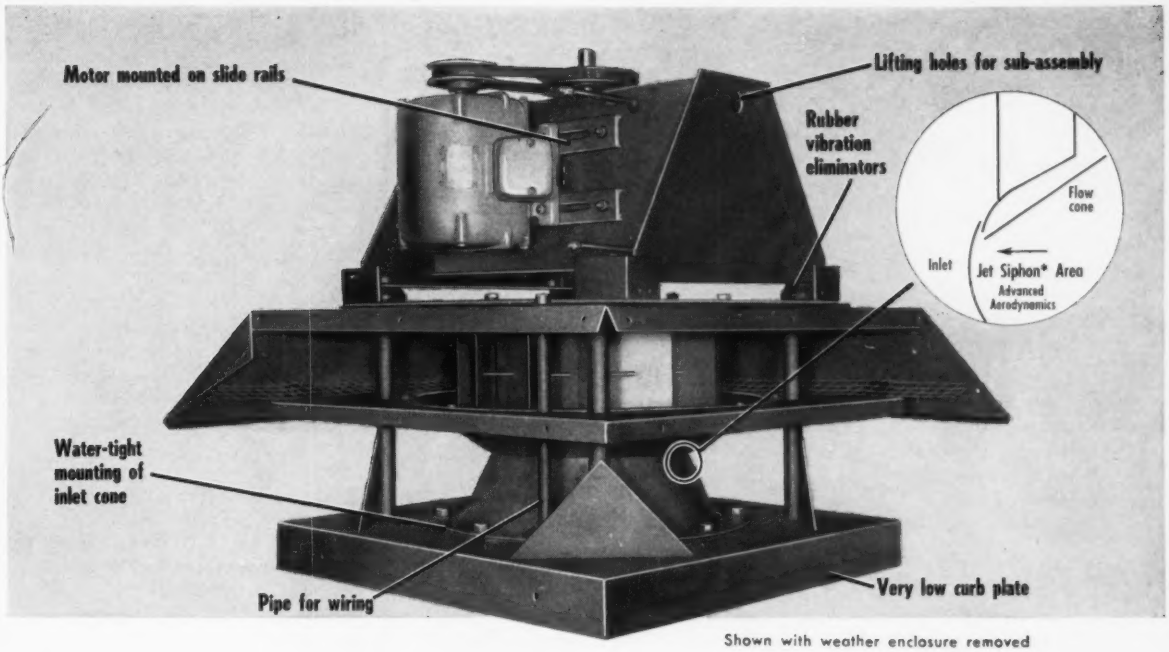
Engineering studies of the plant site, where we hold options on 1700 acres, will resume immediately.

Construction on our $88 million plant will begin this summer. From past experience, we can estimate that about $30 million of the construction cost will be spent locally. . . ."

ASME Lubrication Division holds symposiums

► DURING THE ANNUAL MEETING of the American Society of Mechanical Engineers, three symposiums devoted to various phases of lubrication were held.

Design Committee of the Lubrication Division sponsored a symposium dealing with "Recent Developments in



Shown with weather enclosure removed

PLUS VALUES... all yours in the Clarage Centrilator

POWER ROOF VENTILATOR — CENTRIFUGAL TYPE

Jet Siphon* feature for stable, high efficiency.

Static pressures to 2" — thus well suited to both light-duty installations without ductwork and applications where ductwork or hoods impose considerable resistance.

Adaptable to a wide range of motor sizes.

Variable pitch V-belt drive.

Wheel and inlet designed for streamlined air flow.

Built heavy-duty throughout to assure long-lasting, trouble-free service.

Every wheel statically and dynamically balanced on precision machines.

Inspection panel and complete accessibility.

Low overall height.

Venting of motor and drive area.

Engineered and constructed for extra quietness.

Heavy-duty anti-friction bearings.

Simple installation — only 4 bolts required.

Write today for Bulletin 550. Clarage Fan Co., Kalamazoo, Mich.

CLARAGE

*Patent applied for

...dependable equipment for making air your servant

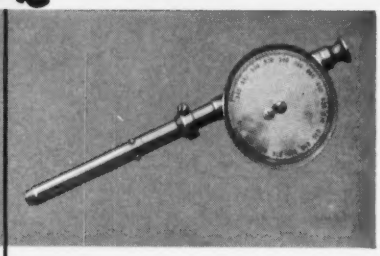
SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

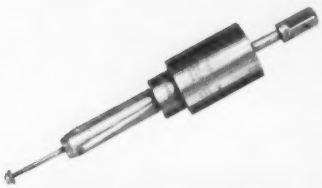
For better small tube maintenance

ELLIOTT TUBE CLEANERS and EXPANDERS

ELLIOTT TUBE GAGE

Measures inside tube diameters in .001". A quick, guide for setting tube expanders for condenser and heat exchanger tubes. Three point contact of hardened steel balls insures accurate measurements.



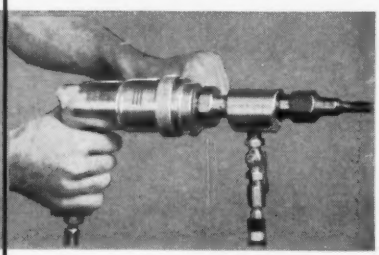


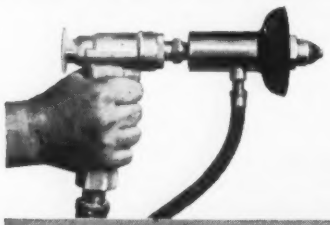
ELLIOTT TUBE EXPANDERS

Roll condenser and heat exchanger tubes quickly and accurately. Rotating, parallel self-feeding rolls insure good joints. For tubes ½ in. through 1½ in., 16 gage.

NEW ELLIOTT 5100 SERIES HEAT EXCHANGER TUBE CLEANER

Powerful air-driven motor with non-rotating, water feeding attachment, trigger-action for motor control, finger-action valve for water flow. Built-in speed governor eliminates shaft-whip. Choice of two sizes.



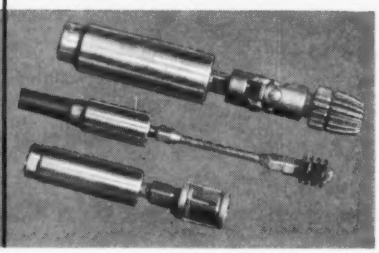


ELLIOTT JIFFY GUN WITH BOOSTER

Combines water and air pressure for extra power and speed, recommended where water pressure is low, or scale deposit is heavy.

ELLIOTT 600 Series Cleaners

For straight and curved small tubes. Air or steam driven motors. Can be equipped with expanding brushes and scraper heads.



Y6-10

Write for Descriptive Literature

Address Elliott Company, Lagonda Division, Springfield, Ohio

ELLIOTT Company

STEAM TURBINES • MOTORS • GENERATORS • DEAERATING HEATERS • EJECTORS • CONDENSERS • CENTRIFUGAL COMPRESSORS • TURBOCHARGERS • TUBE CLEANERS • ETRAINERS

REPORTS from the FIELD

Begins on page 154

Bearings Operating Under Extreme Conditions." New officers of the Design Committee are: T A Herman, Chairman; V S Wagner, Vice Chairman; A M Loeb, Secretary.

The Research Technical Committee sponsored two sessions that included a report on boundary-lubrication research at MIT and discussions on the viscoelastic behavior of greases. New officers of the Research Technical Committee are C C Moore, Chairman; P G Reynolds, Vice Chairman, and R L Wehe, Secretary.

New officers of the Builders and Operators Technical Committee are P C Warner, Chairman; D L Lynch, Vice Chairman, and R H Josephson, Secretary. This committee, for the first time, sponsored a symposium which dealt with the need for, and operating problems involved in, the use of fire resistant fluids and lubricants.

New officers of the Lubrication Division are: O C Bridgeman, Chairman; J T Bunting, Vice Chairman, and W H White, Secretary.

Calendar of Events

April 7-10—American Society of Mechanical Engineers, Instruments and Regulators Conference. Northwestern Univ, Chicago, Ill. Details from ASME, 29 W 39th St, New York 18, N. Y.

April 8-9—American Institute of Electrical Engineers, Ninth Conference on Rubber and Plastics. Mayflower Hotel, Akron, Ohio. Details from AIEE, 33 W 39th St, New York 18, N. Y.

April 8-10—American Society of Mechanical Engineers, Spring Meeting. Dinkler-Tutwiler Hotel, Birmingham, Ala. Details from ASME, 29 W 39th St, New York 18, N. Y.

April 8-10—American Institute of Mining, Metallurgical and Petroleum Engineers, Fortieth Annual Conference of the Blast Furnace, Coke Oven and Raw Materials Committee and the National Open Hearth Steel Committee. Penn-Sheraton Hotel, Pittsburgh, Pa. Details from AIME, 29 W 39th St, New York 18, N. Y.

April 8-11—Rural Electrification Administration, Eighth Annual Electric Generating Plant Operation and Maintenance Conference. Phillips Hotel, Kansas City, Mo. Details from Andrew S Rieff, N W Electric Power Cooperative, Inc, 312 N Chestnut St, Cameron, Mo.

April 15-17—Oil Heat Institute of America and Mechanical Engineering

MOTORITE
Cut Gaskets
STRONGLY WOVEN for HEAVY DUTY JOBS

Anchor's MOTORITE red and black sheet consists of high quality asbestos yarn . . . a strongly woven gasket sheet reinforced with fine brass wire twisted into each yarn and woven into sheet form with close weave. To give this gasket material further resistance to hard wear, it is treated with a high heat-resisting compound, one side graphited to allow the joint to be broken without gasket adhesion.

Style 406 MOTORITE is widely used for automobile motor flange joints, for superheat steam gaskets, and especially useful for manifold gaskets in internal combustion engines. Likewise it is excellent on cylinder heads and steam hammers.

We invite you to write us your requirements today, or request special details.

DISTRICT OFFICES

BALTIMORE, MD.
BOSTON, MASS.
BUFFALO, N.Y.
CINCINNATI, OHIO
CHICAGO, ILL.
CLEVELAND, OHIO
DAYTON, OHIO
DETROIT, MICH.
HOUSTON, TEX.
INDIANAPOLIS, IND.
LOS ANGELES, CAL.
MILWAUKEE, WIS.
MONTREAL, CANADA
NEW ORLEANS, LA.
NEW YORK, N.Y.
PHILADELPHIA, PA.
PITTSBURGH, PA.
SAN FRANCISCO, CAL.
SEATTLE, WASH.
SPOKANE, WASH.
ST. LOUIS, MO.
TOLEDO, OHIO
WILMINGTON, CAL.

THE ANCHOR PACKING COMPANY

GENERAL OFFICES: PHILADELPHIA, PA.
FACTORIES: MANHEIM, PA. ELKHART, IND. MONTREAL, CAN.

FIBROUS AND METALLIC PACKINGS FOR EVERY INDUSTRIAL PURPOSE

CONSTRUCTION FEATURES --- PLUS CONTROLLED QUALITY

make Your Choice of the

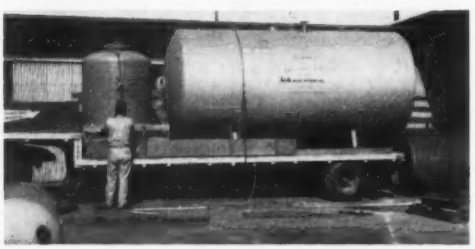
L★A Deaerator

a Wise One indeed!

- Always completely assembled in our own shop
- Always fabricated by our own skilled employees
- Constantly supervised by our own engineers
- Fabricated of highest quality materials
- API-ASME approved shop
- Always a fine check-out of assembled unit
- One complete bulk shipment
- Jet atomizing, tray and combinations available
- All stainless steel internals
- Self-adjusting to all loads
- 10,000 to 2,000,000 lbs. per hr. capacities

Automatic welding machine in L★A shop

From your initial inquiry through the shipment of the completed deaerator, L★A Water Softener Co. takes complete responsibility. You are assured of the finest workmanship and control with constant inspection and supervision by our qualified engineers as fabrication and assembly proceed. Consistant top quality equipment is the result.



100,000 lbs. per hr., 10 min. storage unit being loaded for delivery to eastern chemical manufacturer

You KNOW where your L★A Deaerator is made! And this complete control from one source enables L★A to deliver **on schedule** and ready for quick installation.

May we send you a copy of our new Deaerator booklet? Simply ask for Bulletin 102-A

L★A WATER SOFTENER COMPANY

1007 Air Way, Glendale 1, California

REPRESENTATIVES IN PRINCIPAL CITIES

Demineralizers • Hot Process Softeners • Floc Treators • Deaerators • Zeolite Softeners • Dealkalizers

REPORTS from the FIELD

Begins on page 154

Dept, NYU, National Conference on Oil Burning and Oil Burning Equipment. Gould Student Center, University Heights campus, Bronx. Details from Oil Heat Institute of America 500 5th Ave, New York 36, N. Y.

April 16-17—American Institute of Mining, Metallurgical and Petroleum Engineers, Conference on High-temperature Materials for Use in Aircraft, Missiles and Nuclear Reactors. Hotel Carter, Cleveland, Ohio. Details from AIME, 29 W 39th St, New York 18, N. Y.

April 25-26—American Society of Mechanical Engineers, Management-SAM Conference, Statler Hotel, New York. Details from ASME, 29 W 39th St, New York 18, N. Y.

May 1-3—Society for Experimental Stress Analysis, 1957 Spring Meeting and Exhibit, Hotel Statler, Boston, Mass. Details from Dr M W Murray, Secretary-Treasurer, SESA, PO Box 168, Cambridge 39, Mass.

May 4-8—Western Air Conditioning Industries Assn, Western Air Conditioning, Heating, Ventilating and Refrigeration Exhibit and Conference. Shrine Exposition Hall, Los Angeles, Calif. Details from Fred J Tabery, 3443 S Hill St, Los Angeles, Calif.

May 7-9—American Institute of Electrical Engineers, joint district meeting. Dayton-Biltmore Hotel, Dayton, Ohio. Details from AIEE, 33 W 39th St, New York 18, N. Y.

May 14-16—Industrial Nuclear Technology Conference, sponsored by Armour Research Foundation of Illinois Institute of Technology and *Nucleonics* magazine, Museum of Science and Industry, Chicago. Details from Dr Leonard Rieffel, Armour Research Foundation, 10 W 35th St, Chicago 16, Ill.

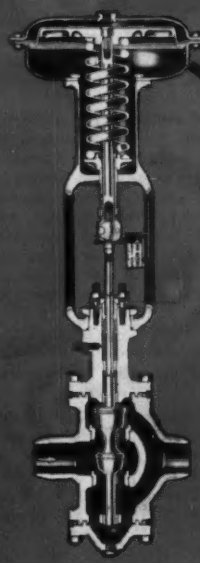
May 20-23—American Society of Mechanical Engineers, Oil and Gas Power Conference. Kentucky Hotel, Louisville, Kentucky. Details from ASME, 29 W 39th St, New York 18, N. Y.

May 20-22—National Assn of Corrosion Engineers, Northeast Region Spring Conference on "Corrosion Control by Choice of Materials." Syracuse Univ and Hotel, Syracuse, N. Y. Details from O R Broberg, Lamson Corp, Syracuse, N. Y.

Low-cost electric power from atomic energy looms closer to reality with the disclosure that organic chemicals may be the means to low-pressure cooling and moderating systems in nuclear reactors, permitting simpler and cheaper installations. Isopropylbiphenyl, newest commercial derivative of biphenyl, is best potential coolant-moderator.

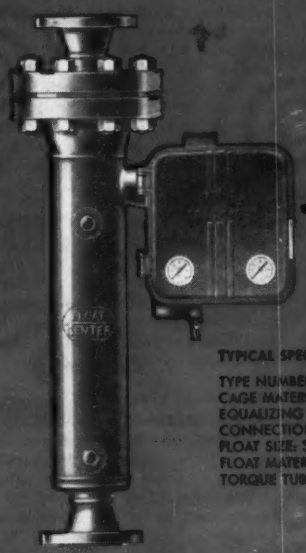
FISHER®

TAILOR MADE for Heater Drain Control



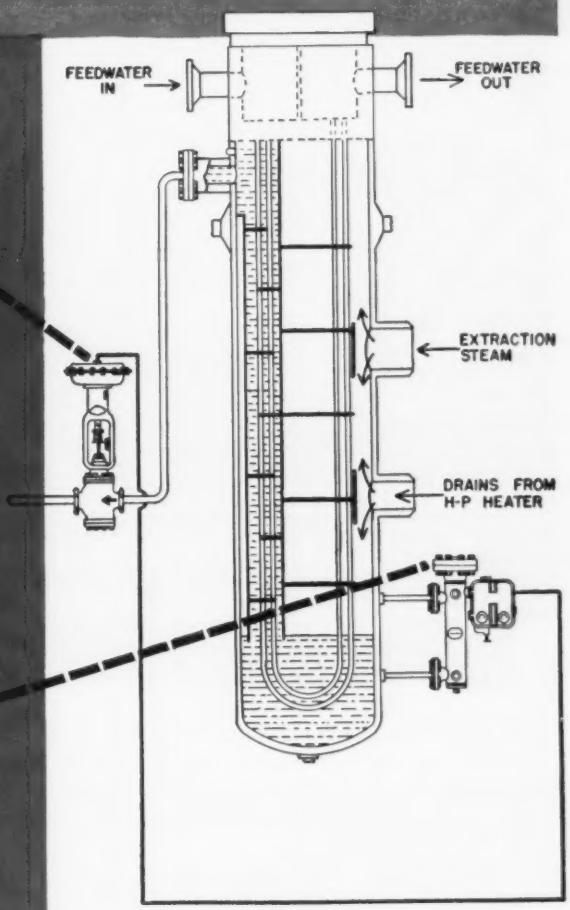
TYPICAL SPECIFICATIONS:

TYPE NUMBER: 657A
BODY END CONN: 2" Welding End
BODY MATERIAL: C5 Chrome Moly
VALVE TRIM: 316SS, Stellited seat welded rings
INNER VALVE: Double port Throttle Plug
PACKING: Teflon
Air to Diaphragm—3 to 15 psi



TYPICAL SPECIFICATIONS:

TYPE NUMBER: 2500R—259B
CAGE MATERIAL: WCB Steel
EQUALIZING CONN: Top and bottom, F-1
CONNECTION SIZE: 2" 600 lb. ASA Fgd.
FLOAT SIZE: 3" x 14"
FLOAT MATERIAL: 304 St. Steel
TORQUE TUBE: K-monel



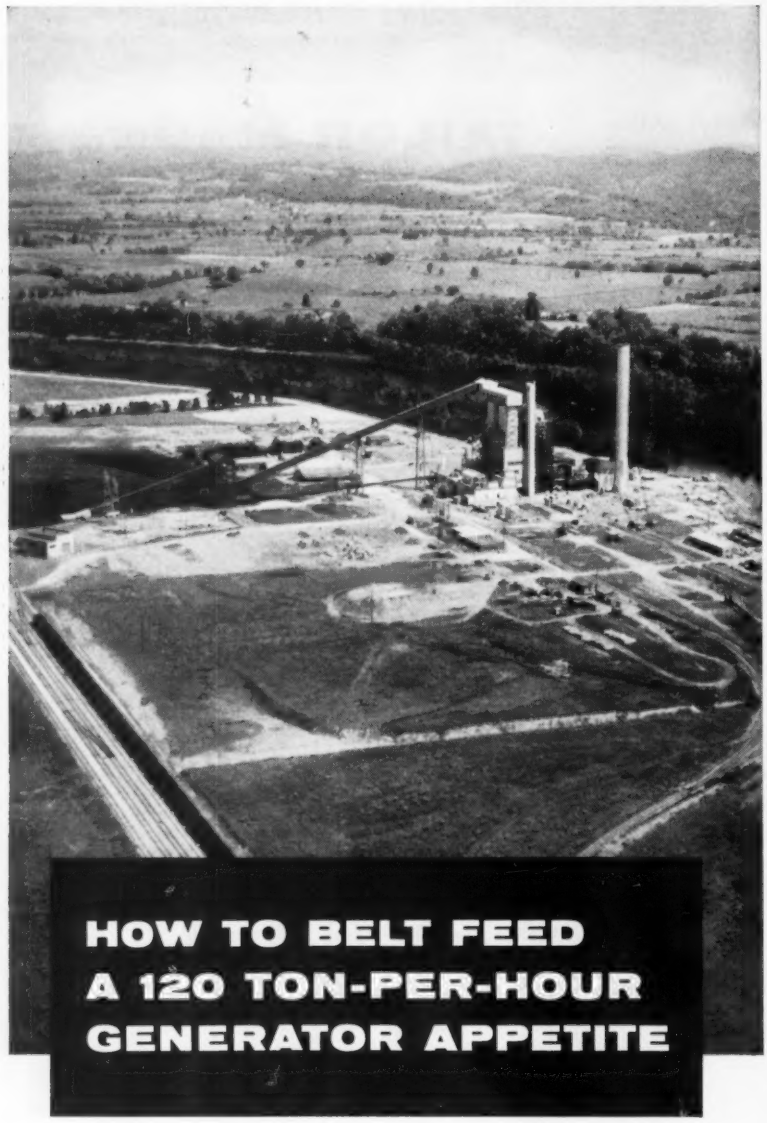
Years of experience in supplying control valves and Level-Trols to steam and power plants has supplied Fisher with the knowledge and ability to build heater drain equipment that will stand up, year in and year out, with a minimum of maintenance.

FISHER GOVERNOR COMPANY • MARSHALLTOWN, IOWA

CANADIAN PLANT: WOODSTOCK, ONTARIO

WORLD LEADER IN RESEARCH FOR BETTER PRESSURE AND LIQUID LEVEL CONTROL

FISHER *Since 1880*



Pennsylvania Power & Light Company's two units at Martins Creek "eat up" 120 tons of coal per hour in generating 160,000 kw each. In coping with this huge appetite problem, PP&L uses a completely automatic coal handling system developed by Hewitt-Robins.

The 600 ton-per-hour capacity system includes an H-R Heavy Duty Car Shakeout, an H-R Gyrex® Scalping Screen, four belt conveyors, two belt feeders and operating machinery. Working through Ebasco Services, Incorporated, Hewitt-Robins engineered, manufactured and installed the entire coal handling system. To find out how H-R products and services can help you, consult your classified telephone directory for the nearest H-R representative, or contact Hewitt-Robins, Stamford, Conn.

HR HEWITT-ROBINS

CONVEYOR BELTING AND IDLERS...POWER TRANSMISSION DRIVES
INDUSTRIAL HOSE...VIBRATING CONVEYORS, SCREENS & SHAKEOUTS

More FREE LITERATURE

Begins on page 169

11 **Air compressors,** 1/3 to 20 hp, for automotive and industrial use are subjects of 20-p illustrated catalog. Booklet includes specs, charts, data, and information on compressed air. Kellog Division, American Brake Shoe Company, Rochester 9, N. Y.

CONTROLS, ELECTRICAL & MECHANICAL

12 **Voltage regulators** for alternating current generators up to 25,000 kva are described in bulletin 14B6035C. Contains construction and operating features. Allis-Chalmers Mfg Co, 952 S 79th St, Milwaukee, Wis.

13 **Automatic controls** are subject of catalog 857. Publication lists controls for single stage pressure, two-stage pressure, differential pressure, single-stage temperature, two-stage temperature, liquid level and mechanical movement. Descriptions, specs and engineering data can be located by dual index. Mercoid Corp, 4201 Belmont Ave, Chicago 41, Ill.

14 **Pneumatic controllers** for temperature and pressure are described in 7-p catalog C $\frac{600}{700}$ 1. Contains temperature and pressure ranges, length of eccentric scale and measuring accuracy. Minneapolis-Honeywell Regulator Co, Wayne and Windrim Aves, Philadelphia 44, Pa.

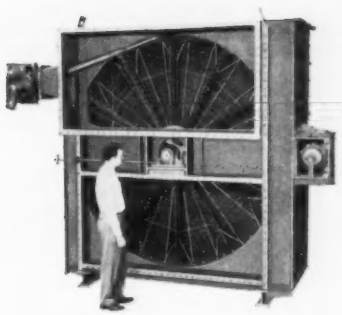
15 **Electric temperature control** systems are described in 16-p illustrated booklet. Written in non-technical language, it explains the correct application of electric controls, the use of control centers to simplify installation and operation, air distribution products to obtain best results from heating and air-conditioning systems used in institutional buildings. Barber-Colman Co, 1300 Rock St, Rockford, Ill.

16 **Analog computation** and high speed instruments are subjects of 8-p question and answer booklet. Contains definitions of certain types of computers and summarizes applications of each. GPS Instrument Co, Inc, 811 Boylston St, Boston 16, Mass.

17 **Computing relay** for pneumatic control systems is subject of 4-p brochure p99-3. Describes features, application and operating characteristics. Explains proportional, reset and rate control actions, and provides equations of computing actions. Bailey Meter Co, 1050 Ivanhoe Rd, Cleveland 10, Ohio.

ELECTRICAL EQUIPMENT

18 **Indoor oil circuit breakers** are described in 16-p bulletin GEA-6465. Contains pictures and drawings



HOW MANY STACK BTUs DO YOU BUY EACH YEAR?

Whether you burn it — or dissipate it up the stack — every BTU costs you money. In fact:

Yearly cost of fuel often equals the cost of your boiler. That's why heat recovery — or dollar recovery — is so important. Boilers simply have huge appetites for fuel . . . fuel that's constantly going up and up in cost.

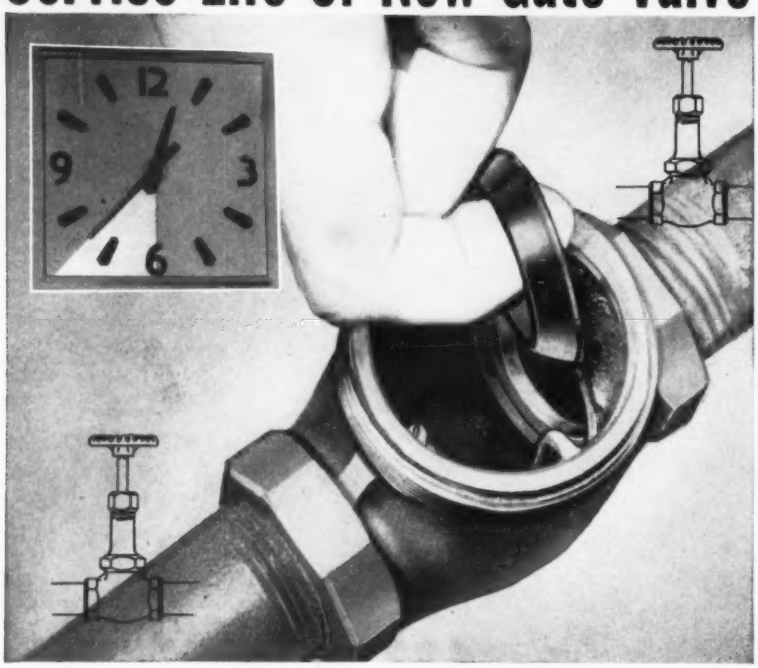
And small boilers are no exception. Even with relatively small boilers — that is, between 25,000 and 250,000 lbs per hr — substantial heat recovery is possible. With a Package Ljungstrom Air Preheater, fuel consumption is most often reduced 10% or more! As a result, many plants have written off their Ljungstrom within two years.

Get more steam, and cleaner stack gases. Put it another way. The BTUs that you save with a Package Ljungstrom can be used to increase boiler output. What's more, higher combustion temperatures cut slagging . . . keep stack gases clean . . . allow use of cheaper fuels . . . reduce corrosion.

Comes complete, ready to install. Determine for yourself how easily a low-cost, *shop-assembled* Package Ljungstrom can be applied to your generating or process system. Ask for our brand-new 16-page brochure. It's yours with our compliments, simply by writing to the address below.

The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.

Only 7 to 10 Minutes to Renew Service Life of New Gate Valve



Patented development assures replacement of seat ring while valve remains installed.

Without removing the valve body from the line, you replace the nickel-alloy seat rings in Fairbanks new patented Renewable Seat Ring Gate Valves. In 7 to 10 minutes, from the time the line is shut down until it is put back into operation, you have given a new service life, a new life of dependable tight closure to your valve.

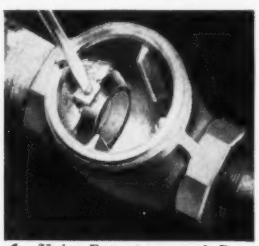
Just 7 to 10 minutes of your maintenance man's time — only 7 to 10 minutes of "down-time" on your steam, water or process piping lines — and you have the equivalent of a new valve in the line. Think of the savings: where once at least one hour, under the most ideal conditions, was required to replace a gate valve in the line, the job is now accomplished in from 7 to 10 minutes.

Field tested for over two years, under all conditions from steam to corrosive liquids, the revolutionary new Fairbanks Renewable Seat Ring Bronze Gate Valve has proven completely satisfactory — absolutely dependable.

Made with either rising stem or non-rising stem construction in ½",¾",1", 1¼",1½" and 2" sizes, the Fairbanks Renewable Seat Ring Bronze Gate Valves are recommended for severe service conditions on 200 lb. steam pressure at 550 degrees F., 400 lb. water, oil or gas pressure — non-shock — lines requiring full flow and subject to frequent operation. Nickel alloy seat rings and wedge make the valves particularly tough and corrosion resistant.

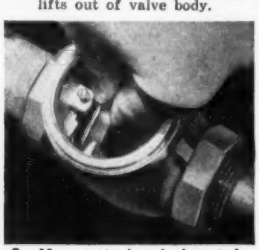
YOURS ON REQUEST: Illustrated, descriptive folder gives complete information on Fairbanks Renewable Seat Ring Gate Valve with details and specifications. Yours without charge. Write today.

THE **Fairbanks** COMPANY
393 Lafayette Street, New York 3, N. Y.
Branches:
New York 3 • Boston 10 • Pittsburgh 22 • Rome, Ga.
Valves • Trucks • Casters • Wheels • Dart & "PIC" Unions



1. Union Bonnet removed. Retaining screw loosened with ordinary screwdriver.

2. Finger hooks inside nickel alloy seat ring. Seat ring lifts out of valve body.



3. New seat ring is inserted. Retaining screw tightened. Bonnet replaced.

More FREE LITERATURE

Begins on page 169

of four types of breakers. Also includes application information and charts which list ratings, insulation levels and interrupting capacities of equipment. General Electric Co, Schenectady 5, N. Y.

19 **Raceway techniques** for electrical wiring are described in 8-p bulletin S-301. Booklet outlines methods for simplifying wiring operations from drafting room to assembly floor by use of raceways and pre-cut wires. Contains guide to standard raceways, giving specs, part numbers and sizes. Stahlin Bros, Inc, 474 Maple St, Belding, Mich.

20 **Synchronous timing motors** are subjects of data sheet #150. Bulletin includes all specs, descriptions of special features and uses, and detail drawings illustrating standard brass pinions and ratchets applications. Lux Clock Mfg Co, Inc, 95 Johnson St, Waterbury 20, Conn.

21 **Heaters and heating devices** are subjects of 72-p catalog GEC-1005H. Catalog includes a 16-p power requirements section, showing short and long form calculations for heating applications; also describes redesigned cartridge heaters, miniature soldering irons, aluminized steel sheath strip heaters, new ratings and configurations of finned tubular heaters, ceramic-to-metal and plastic resin hermetic seals. General Electric Co, Schenectady 5, N. Y.

HEAT EXCHANGERS

22 **Shell and tube** heat exchange equipment is subject of 4-p bulletin HE-1. Construction features, general specs and standard materials are outlined in tabular form. Heat Transfer Co, 145 Sussex Rd, W Englewood, N. J.

23 **Heat exchangers** for generator cooling and chemical processing are described in Bulletin 1200. Applications of each type of unit are illustrated and explained. Griscom-Russell Co, Massillon, Ohio.

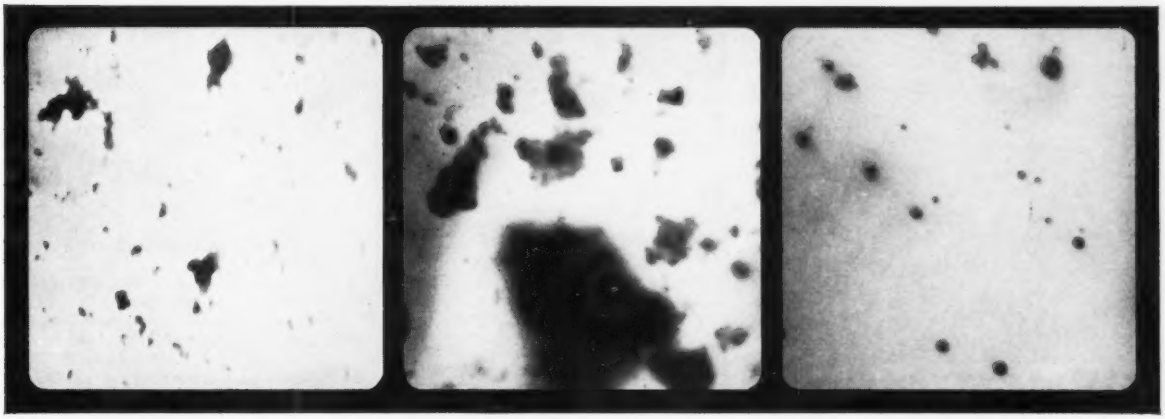
24 **Industrial maintenance** products are subject of 6-p catalog. Catalog covers 12 products including factory window coating and a protective coating for rusted metal. Skybrite Co, 3125 Perkins Ave, Cleveland 14, Ohio.

25 **Protective coatings** are subject of 32-p full color manual. Provides a guide for buyers and users of such coatings. Contains information and recommendations which enable user to determine specific coatings needed to protect rustable surfaces. Rust-Oleum Corp, 2799 Oakton St, Evanston, Ill.

26 **Maintenance program** for medium voltage, metal-clad switchgear

Proof... Only PEROLIN® Treated Fuel Oils Can Show These Results

Electron Micrographs by Independent Research Foundation and Other Comparative Tests Prove NEW Perolin Fuel Oil Treatment's Unique Properties



FRESH OIL

Magnified 8,700 times

This micrograph illustrates the size and amount of asphaltene particles that exist in a normal sample of commercial Bunker "C" #6 fuel oil as a natural result of oxidation.

AGED OIL

Magnified 8,700 times

Here further oxidation and polymerization of the oil have caused these particles to collect into larger masses. These are the major cause of fuel oil and combustion problems.

PEROLIN TREATED OIL

Magnified 8,700 times

This shows how effectively Perolin stabilizes the oil and prevents the formation of these particles. In fact, you can see that Perolin actually reduces overall particle size.

These electron micrographs present visible proof, confirmed by extensive field experience, that Perolin Fuel Oil Treatments work to end your fuel oil problems.

Perolin's beneficial results are immediately evident. No longer are you troubled by clogged strainers and filters, plugged fuel lines, carbonized preheaters, imperfect atomization and carbon build-up caused by these particles.

Test Reports and Technical Bulletins are available that further prove Perolin's unrivaled performance. They conclusively show that Perolin overcomes problems caused by water in the oil, prevents corrosion in the fuel system, reduces soot and residue formation due to incomplete atomization, and disperses sludge—reclaiming otherwise lost Btu's.

Various formulations of Perolin Fuel Oil Treatments are available—at a cost of a few cents per 100 gallons of oil—for all types of oil burners and diesel engines.

Fill in the coupon below for full information.

Perolin SINCE 1904 ®

The PEROLIN COMPANY, Inc.

Manufacturing Chemists

350 Fifth Avenue, New York 1, N. Y.
1112 W. 37th Street, Chicago 9, Illinois

A HALF CENTURY OF EXPERIENCE THE WORLD OVER

PC 124

THE PEROLIN COMPANY, INC.
350 Fifth Avenue, New York 1, N. Y. 1112 West 37th Street, Chicago 9, Ill.

Gentlemen: Please send me test data and full information on Perolin Fuel Oil Treatments:

We burn_____ gallons of No._____ oil a year.

☐ *Please have your representative call.*

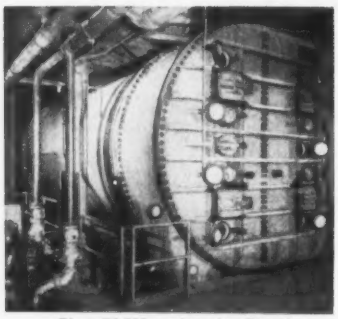
*Name*_____ *Title*_____

*Company*_____

*Address*_____

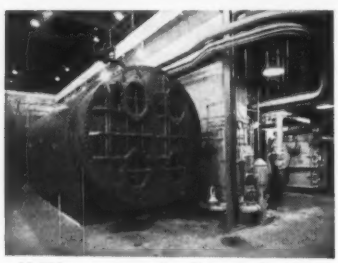
*City*_____ *Zone*____ *State*_____

The BIGGER the BETTER



Three 70,000 sq. ft. units, City of Los Angeles, Cal.

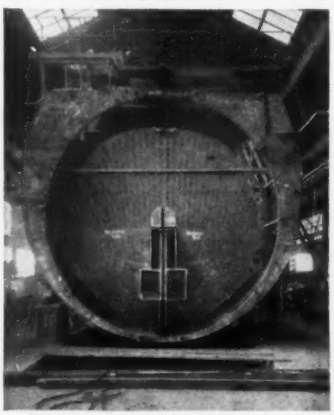
One 45,000 sq. ft. unit and two 20,000 sq. ft. units, Puerto Rico Water Resources.



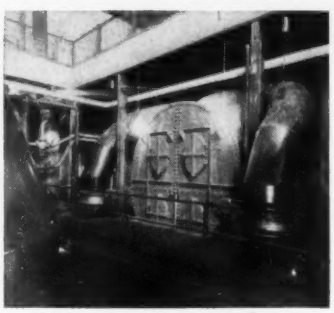
28,000 sq. ft. unit, City of Owensboro, Kentucky.

CONSECO

CONDENSERS



33,000 sq. ft. unit, Penn Power Company, Newcastle, Pa. Under Construction.

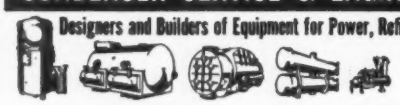


33,000 sq. ft. unit Penn Power Company, Newcastle, Pa. Installed.

NO matter what size units you need, CONSECO gives you what it takes to produce them . . . thirty years experienced engineering, sound design, dependable manufacture, better performance . . . at lowest ultimate cost. *Write for descriptive Bulletin.**

CONDENSER SERVICE & ENGINEERING CO., INC. CONSECO

Designers and Builders of Equipment for Power, Refining, Chemical and Marine Industries



164 OBSERVER HIGHWAY
HOBOKEN, N. J.

CONSECO DESIGNS AND BUILDS

*WRITE TODAY FOR THIS CONSECO BULLETIN ON CONDENSERS AND CUT YOUR POWER COSTS

Heat Exchangers • Condensers Feed Water Heaters • Pressure Vessels • Evaporators • Steam Jet Air Ejectors • Filters and Strainers • Instruments • Sewage Ejectors • Condensate Coolers • Specialty Items • Engine Parts • Service Water Coolers.

More FREE LITERATURE

Begins on page 169

and air magnetic oil-filled types of power circuit breakers is described in 8-p bulletin GER-1282. Includes photos of various phases of inspection and maintenance and contains a trouble-shooting chart. General Electric, Schenectady 5, N. Y.

MATERIALS HANDLING

27 **Rotary feeder** for heavy duty materials handling applications are described in 6-p bulletin DVc. Contains selection tables, photos, cut-a-way drawings. Allen-Sherman-Hoff Co, 295 E Lancaster Ave, Wynnewood, Pa.

28 **Speed reducers** designed for screw conveyor application are described in 7-p catalog SCD-57. Contains directions and selection tables, photos. American Pulley Company, 4201 Wissahickon Ave, Philadelphia, Pa.

METERS AND INSTRUMENTS

29 **Meters,** single-phase, polyphase and watthour demand, as well as water heater time switches and meter sockets are described in 64-p catalog GEC-1400. General Electric Co, Schenectady 5, N. Y.

30 **Combustion-testing** and air-measurement instruments are described in bulletin 138. General Scientific Equipment Co, 7516 Limekiln Pike, Philadelphia 50, Pa.

31 **Gage accessories** are described in 3-p bulletin 600. Contains tables, cutaway views and mounting dimensions. United States Gauge, Sellersville, Pa.

32 **Meters, regulators and valves** are described in revised catalog C-5000, Rev 8. Contains specs and photos. Meter and Valve Div, Rockwell Mfg Co, 400 N Lexington Ave, Pittsburgh 8, Pa.

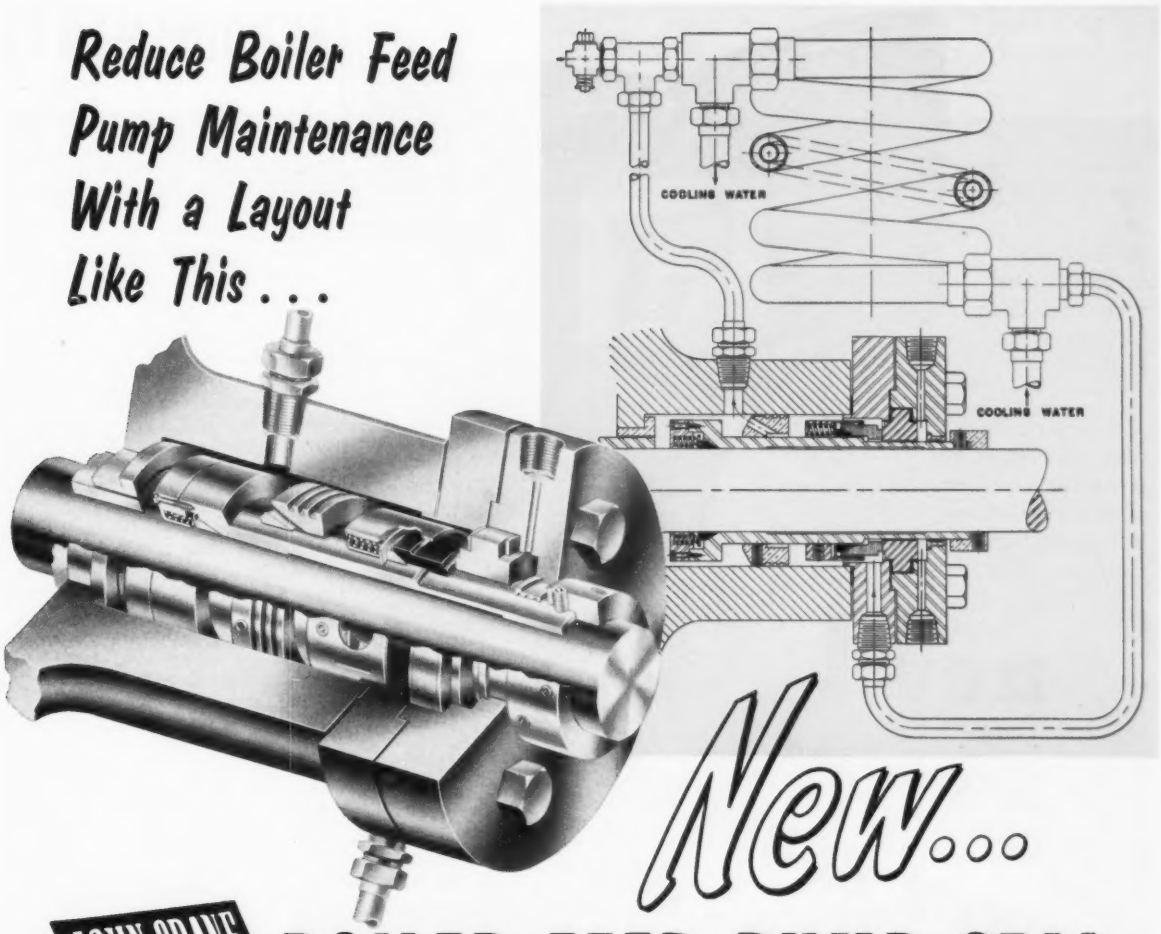
PIPES, VALVES, FITTINGS AND SPECIALTIES

33 **Self-sealing pipe fitting** is described in 8-p bulletin. Contains installation diagram, applications and a questionnaire. Tru-Seal Div, Frick-Reedy Corp, 2040 N Hawthorne Ave, Melrose Park, Ill.

34 **Bronze and steel valves** are described in 80-p catalog. Engineering data such as material specs, flow charts, temperature and pressure ratings are included in catalog. Manning, Maxwell & Moore, Inc, Stratford, Conn.

A 50-kw nuclear research reactor to be located in West Berlin, Germany, will be built by Atomics International. To be built for the Senate of Berlin, the reactor will be located at the Institute for Nuclear Research, a nuclear study center being built in a suburb of West Berlin.

Reduce Boiler Feed Pump Maintenance With a Layout Like This . . .



New . . .

JOHN CRANE BOILER FEED PUMP SEAL

You get cost savings in four ways:

1. Replacement costs and "down time" are reduced. Service life is much longer than with other sealing methods.
2. Maintenance expenses are reduced. Once installed, the seal needs no further attention. Costly replacement of expensive sleeves is eliminated.
3. Long seal life—special closed circulating system provides cooling water in sealing chamber for best seal performance.
4. There is no leakage. Loss of valuable feed water is eliminated.

You get 4-way job-engineered performance:

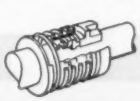
1. "John Crane" engineers the seal to your operation. This includes adaption to your pump design and piping arrangement.
2. You are furnished with carefully drawn up plans. All necessary recommendations are supplied. Heat exchanger size is specified.
3. Package design provides easy installation and removal of seal without major pump dismantling—can be installed as readily in existing equipment as in new pumps.
4. "John Crane's" world-wide service organization and experienced engineering staff stand behind your installation.

Now is the time to investigate this new boiler feed pump seal. Write for new illustrated technical bulletin.

Crane Packing Co., 6430 Oakton St., Morton Grove, Ill. (Chicago Suburb).
In Canada: Crane Packing Co., Ltd., Hamilton, Ont.

JOHN CRANE

MECHANICAL PACKINGS


SHAFT SEALS

TEFLON PRODUCTS

LAPPING MACHINES

THREAD COMPOUNDS

CRANE PACKING COMPANY

ELBOW OUTLET
AND
45° BRANCH
CONNECTIONS
THREADED AND
SOCKET-WELD
ENDS

APPLICATIONS:
DIRECTIONAL FLOW
BRANCHES, THERMOWELL
CONNECTIONS, PIPE
SUPPORT AND HANGER
CONNECTIONS

new!

drop forged

BONNEY ELBOLETS*

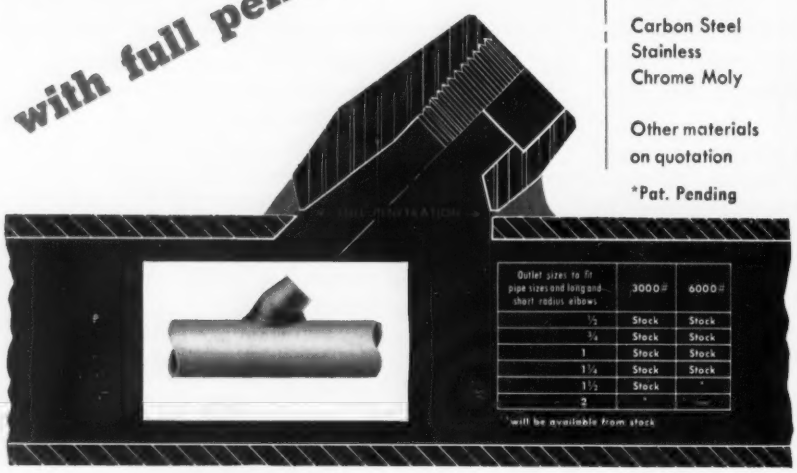
with full penetration weld

Full penetration weld drop forged fittings available from stock in the following materials:

Carbon Steel
Stainless
Chrome Moly

Other materials on quotation

*Pat. Pending



BONNEY

PENNSYLVANIA DIVISION

BONNEY FORGE & TOOL WORKS

DEPT. L ALLENTOWN, PA.

APPOINTMENTS

Corporation executive changes

Henry Vogt Machine Co: G A Heuser, chairman of the board; Henry V Heuser, president. **Horizons Incorporated:** K M Bartlett, president. **A M Byers Company:** J Frederic Byers Jr, chairman of the board; B M Byers, president. **Layne & Bowler, Inc:** James I Seay, chairman of the board; William H Reeves, president; Frank T Quinn, vice-president, manufacturing; A O Fabrin, vice-president, engineering.

McGraw-Edison Company: Charles Edison, chairman of the board; Alfred Bersted, executive vice-president. **Sylvania-Corning Nuclear Corporation:** Lee L Davenport, president; Walter E Kingston, executive vice-president. **Fuller Company:** A E Douglass, chairman of the board; Channing O Davis, president; G K Englehart, president of Sutorbilt Corp of California, a subsidiary.

Pittsburgh Corning Corporation: Russell Brittingham, president. **New York Rubber Corporation:** Herschel G Harris, president; C Bradley Allen, executive vice-president. **Southwest Fabricating & Welding Company:** Ardon B Judd, president. **Weston Electrical Instrument Corp:** Walter W Slocum, executive vice-president. **Johns-Manville Sales Corporation:** Reginald L Johnson, vice-president. **Western Precipitation Corporation:** Norman M McGrane, vice-president.

Operation executive changes

D B Flower Manufacturing Co: Frank Ptacek, manager of production. **The Electric Storage Battery Company:** J S Hudson, corporate director of industrial and public relations. **National Electric Products Corporation:** Frederick J O'Reilly, manager of manufacturing. **The Babcock & Wilcox Company:** Edward Gerstenschlager, manager of production engineering, boiler division. **General Electric Company:** John L Mangan, manager-industry sales, gas turbine dept.

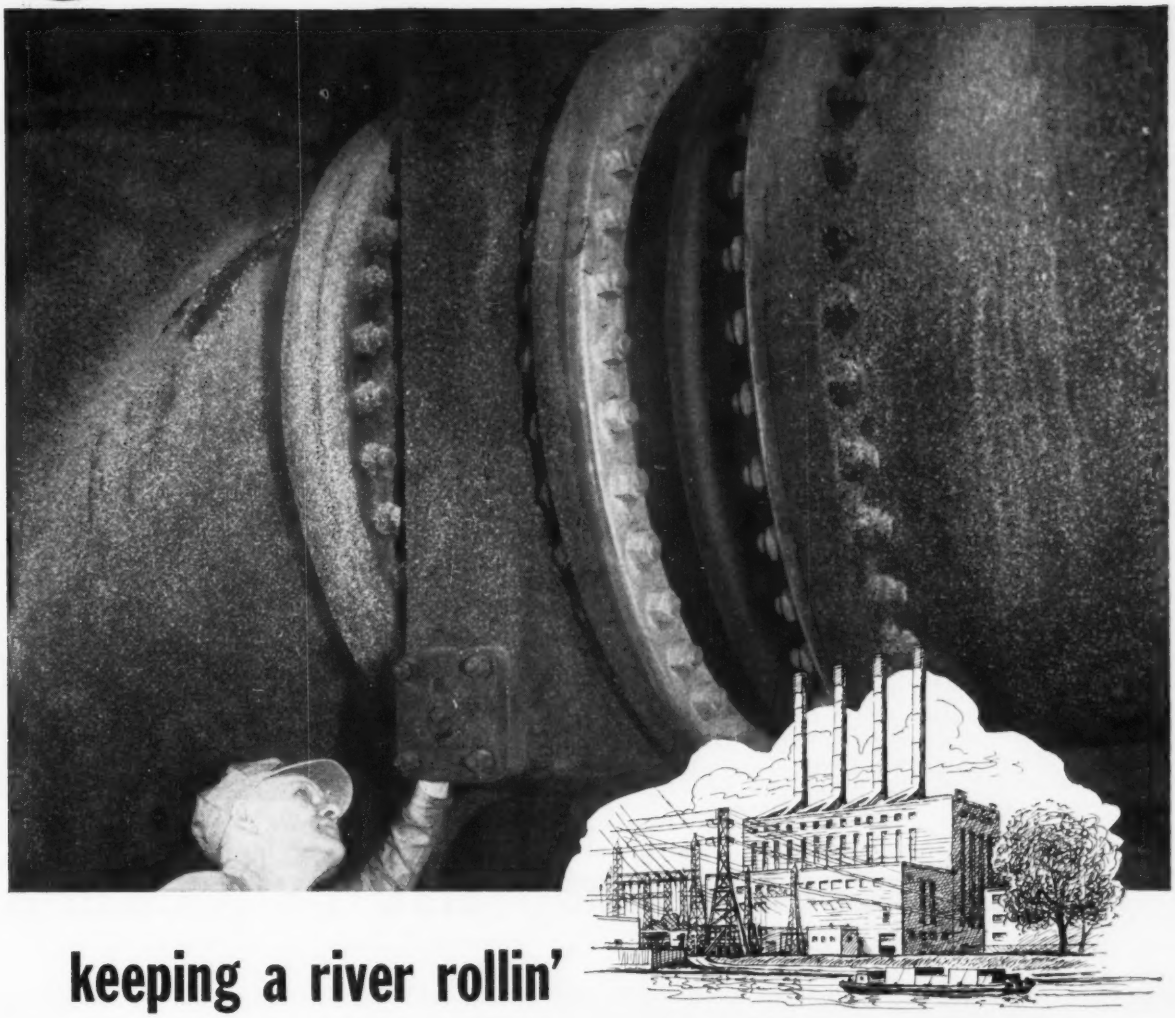
Engineer changes

Union Carbide Nuclear Company: Frank W Hurd, director of research. **Flori Pipe Company:** J F Huitt, chief engineer and Kenneth R Notvest, chief research engineer of Flori-Houston combination. **General Controls Co:** Chester S Beard, chief of control valves and actuators, engineering division.

Allis - Chalmers Manufacturing Company: H D Emmert Jr, chief engineer, steam turbine department; Arthur F Erwin, engineer-in-charge of nuclear pump section. **Hoffman Laboratories Inc:** Richard A Maher, chief engineer. **A M Byers Company:** Ramon I Lindberg, director of cor-

(*Continued on page* 254)

US RUBBER EXPANSION JOINTS



keeping a river rollin' and the pipes from rockin'

A river of 390,000 gallons of water per minute rolls through the four surface condensers in Niagara Mohawk Power's plant at Oswego, New York. Here is generated enough power to heat 384,000 household steam irons every hour. Ravenous furnaces consume 3600 tons of coal every 24 hours at full load.

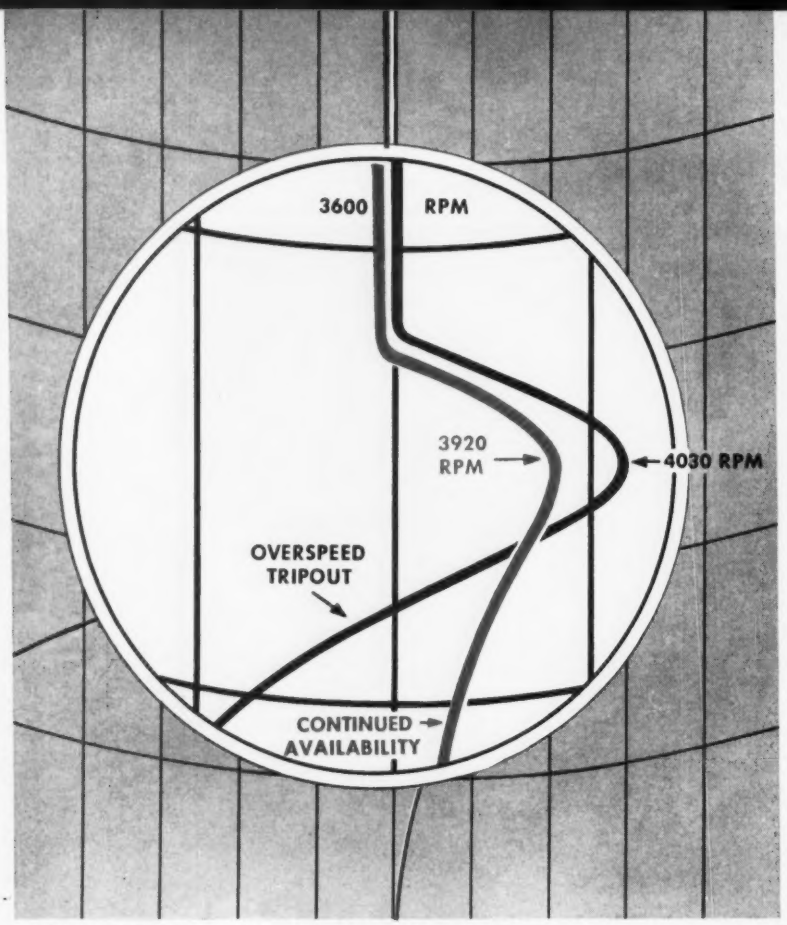
The piping in Niagara's condenser system can't rock or rattle itself to death despite the tremendous capacities and pressures encountered. U. S. Rubber Expansion Joints are the flexible connections that allow the pipes to give and take, to literally ride with the punch.

"These Expansion Joints were installed in 1940," says the plant superintendent, "and they've never given us trouble. We use them in sizes from as small as 6" all the way up to 48", and at water temperatures up to 170 degrees Fahrenheit. We know we will get many more years' wear out of them."

To absorb excess stresses due to expansion and contraction, to insulate against vibration, take care of misalignment, specify U. S. Expansion Joints. They are available at any of the 28 "U.S." District Sales Offices, or write us at Rockefeller Center, New York 20, N. Y.

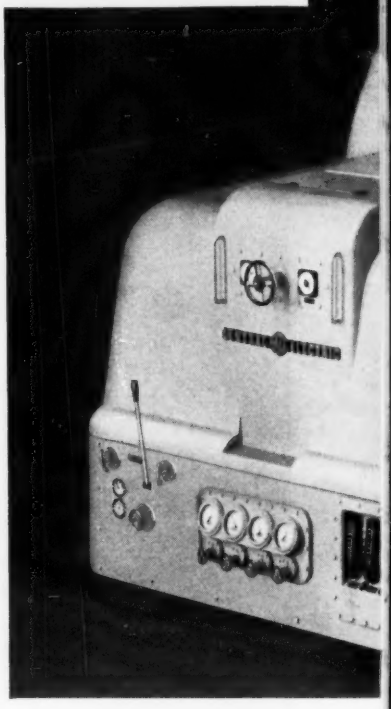
US RUBBER Mechanical Goods Division

United States Rubber



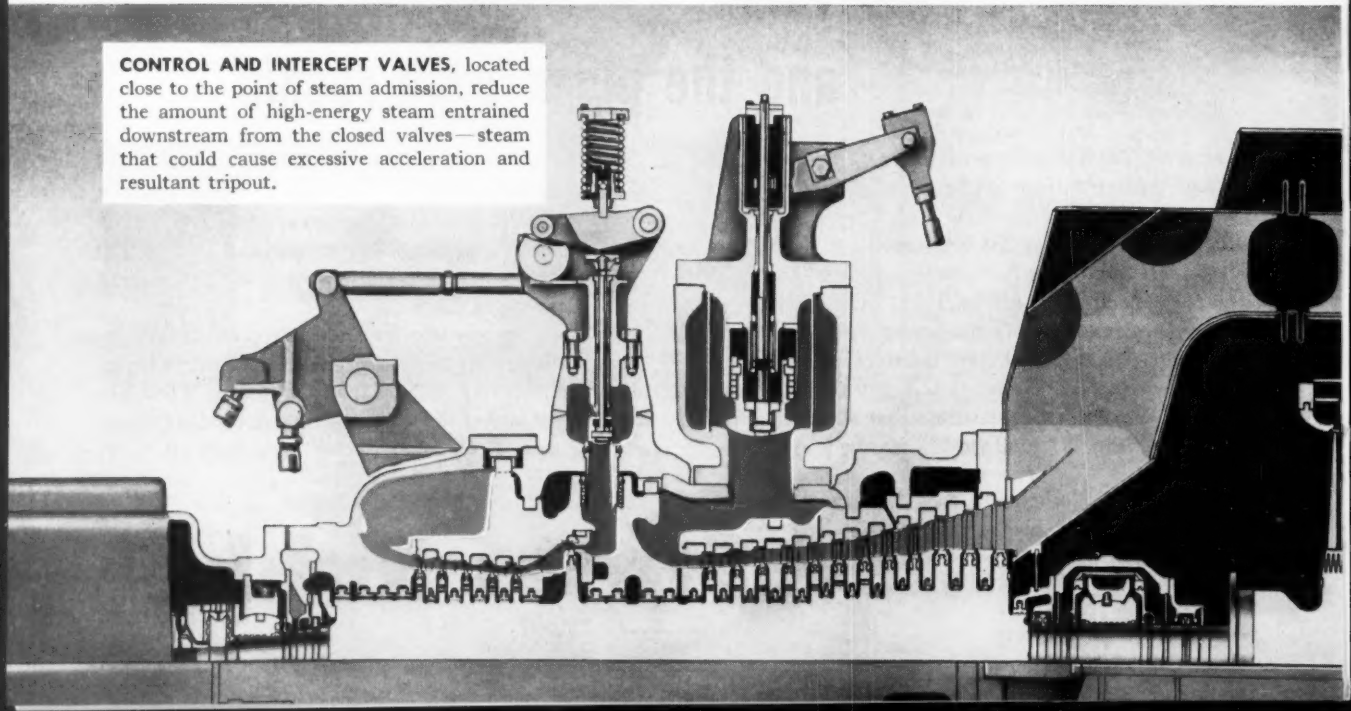
SENSITIVE GOVERNING SYSTEM helps avoid costly tripouts. The red curve, above, shows how a typical G-E reheat turbine stays below tripout speed by limiting speed to 3920 rpm during temporary system interruption. Without this split-second governing response, overspeed to 4030 rpm can result in costly shutdown.

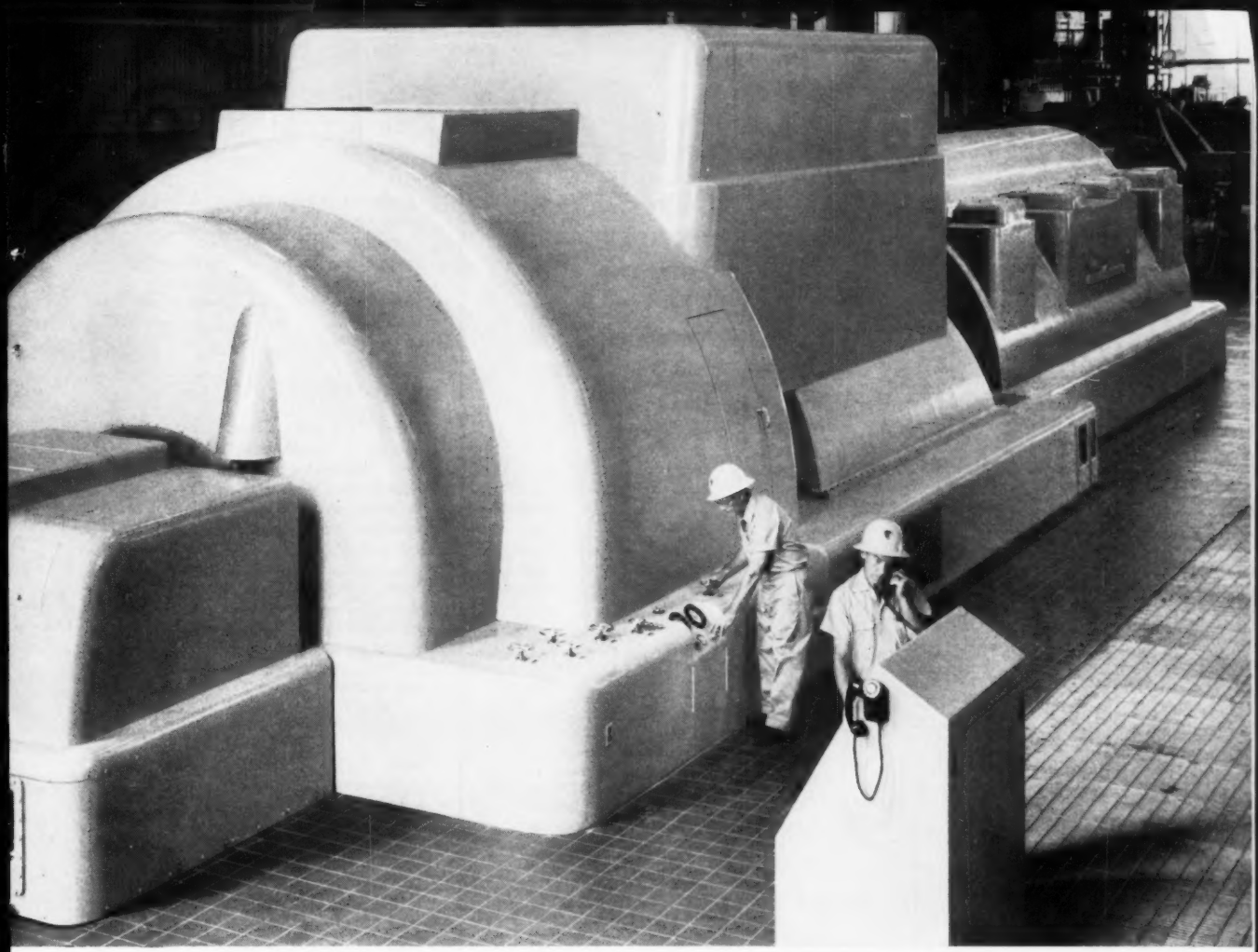
SPLIT-SECOND RESPONSE to system disturbances helps keep units like this on-the-line. Pictured here is a 150,000 kw reheat steam turbine-generator at Oklahoma Gas and Electric Company's Riverbank Station.



Split-second response helps keep

CONTROL AND INTERCEPT VALVES, located close to the point of steam admission, reduce the amount of high-energy steam entrained downstream from the closed valves—steam that could cause excessive acceleration and resultant tripout.





General Electric turbines on-the-line

SENSITIVE GOVERNING SYSTEM COPES WITH TEMPORARY SYSTEM DISTURBANCES

Requirements for sensitive, faster-responding governing systems have steadily increased with the trend toward larger reheat turbines with their inherent high overspeed potential.

Modern turbines entrain significant quantities of high-energy steam downstream from control and intercept valves and in crossover pipes. Because this steam can cause rapid acceleration upon load loss, governing systems must instantly sense speed changes to ride through temporary system disturbances. A split-second time lag may mean the difference between tripout and continued turbine availability.

Locating control and intercept valves as close as possible to the turbine operating stages reduces the amount of high-energy steam trapped downstream from the valves. With the acceleration potential of this entrained steam kept to a minimum, overspeed is limited and the turbine remains on governor control despite temporary system interruptions.

Other refinements such as use of an extremely sensitive governor and relays help make fast response possible. This governor senses the slightest change in speed and transmits a signal to activate the governing system.

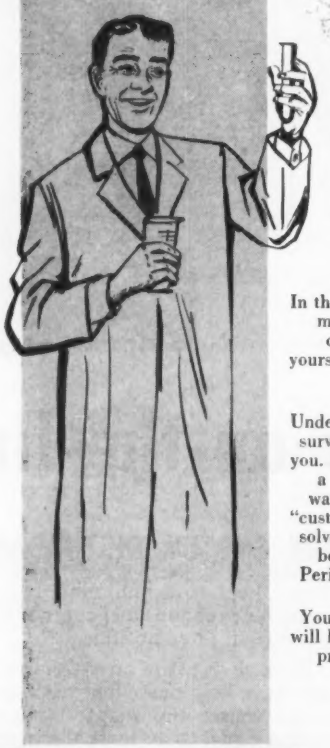
Sensitive response of governing systems is another example of how General Electric turbine research and engineering leadership combine to build tomorrow's turbine-generators today. For further information on reheat turbine overspeed protection, write for bulletin GER-920, Large Steam Turbine-Generator Department, General Electric Company, Schenectady 5, New York. 254-39

Progress Is Our Most Important Product

GENERAL ELECTRIC

Eliminate Boiler Feedwater Problems with DEADY

DEADY Products, Recommendations and Service



There's only one way to keep your boiler feedwater operation efficient. That's by preventing and/or correcting water problems by thorough analysis and investigation of the "problem". Deady Chemical Company has been a specialist in individualized treatment of water problems since 1905.

In that time, Deady engineers have met and mastered every type of industrial water condition and problem. You can avail yourself of Deady's formulated products and specialized know-how through the Deady Service Plan.

Under this plan, Deady Service Engineers survey your particular needs at *no cost* to you. As part of their survey, they will make a complete laboratory analysis of your water supply. After thorough study, the "custom-made" Deady Recommendations to solve your water conditioning problem will be presented to you without obligation. Periodic Deady *Service* "Check-ups" make sure your water is properly treated.

Your small investment in Deady products will be repaid many times over in the plant protection you'll receive. Why not write for the illustrated folder describing the Deady Plan in detail? No obligation, of course.

DEADY

Say: DEE-DEE

DEADY CHEMICAL COMPANY

1401 Fairfax Trafficway
Kansas City 15, Kansas

•

3757 Wilshire Boulevard
Los Angeles, California

Field Service Engineer Headquarters:

Kansas City, Kans.
St. Louis, Mo.
Chicago, Ill.
Milwaukee, Wisc.
Omaha, Nebr.
Davenport, Iowa
Minneapolis, Minn.
Detroit, Mich.
Indianapolis, Ind.
Fort Wayne, Ind.
Cincinnati, Ohio
Toledo, Ohio
Denver, Colo.
Tulsa, Okla.
Los Angeles, Calif.
San Francisco, Calif.
Seattle, Wash.
Pittsburgh, Pa.
Memphis, Tenn.
Chattanooga, Tenn.
Charlotte, N. C.

More APPOINTMENTS

Begins on page 250

rosion research. **Hills-McCanna Company:** Bert S Nelson, director of engineering, products division. **Norton Company:** Osgood J Whittemore Jr, chief ceramic engineer, refractories division. **The Teller Company:** Charles L Zoltani, chief engineer, special machinery division.

Sales changes

Graver Water Conditioning Co: Vincent J Calise, general sales manager. **American-Standard,** Ross Heat Exchanger division: Paul W Wilcox, sales manager; George G Van Tuyl, manager, power-equipment sales, eastern region; Marvin F Schobert, product manager, standard exchangers; Richard J Riedl, product manager, engineered, navy and atomic exchangers; Lawrence M Fletcher, product manager, feedwater heaters; William G Ritchie, product manager, surface condensers and ejectors.

Femco Inc: Addison Davidson Jr, Eastern district sales manager; John W Bauer Jr, western Pennsylvania area; John Taylor, Cleveland, Youngstown, Buffalo; Warren C Sprague, west coast; James Beaven, southern region. **Rockwell Manufacturing Company:** Herbert Parker, Atlantic district manager, meter and valve division. **Graybar Electric Company:** W T Bronson, eastern district manager.

New representatives

For **Hills-McCanna Company:** H D Hale & Company, 8118 Rosalie Ave, St. Louis 17, Mo; The Burhans-Sharpe Company, 1731 First Ave S, Seattle 4, Wash. For **A W Cash Company:** K C Brown Company, 4010 Washington Ave, Kansas City 11, Mo. For **Hoffman Specialty Mfg Corp:** R W Lange Jr, western Michigan area. For **Allen - Sherman - Hoff Company:** Ralph L Williams of Power Equipment Sales, Inc, 77 Summer St, Boston 10, Mass. For **Mexico Refractories Company:** Robert D McWorter, Birmingham, Ala. For **Rodney Metals, Inc:** Herbert G Milner, 261 Fifth Ave, New York, N. Y.

Institute elections

American Institute of Consulting Engineers: Edward H Anson, president; E Sherman Chase, Dean G Edwards, Emil H Praeger, members of the governing Council. **American Society of Lubrication Engineers:** Calvert L Willey, administrative secretary.

A solar energy converter panel, capable of developing 25 watts of electrical power, was among the latest advances in solar energy applications demonstrated recently by Hoffman Electronics Corp, Los Angeles.

5086

HIGHEST STRENGTH ALUMINUM FOR UNFIRED PRESSURE VESSEL FABRICATION

Kaiser Aluminum now offers you alloy 5086 . . . the highest strength aluminum alloy available for the fabrication of unfired pressure vessels.

Non-heat-treatable 5086 is designed specifically for welded structures requiring maximum joint strength and efficiency, plus light weight and corrosion resistance.

And, with high-strength 5086 you can take advantage of inert-gas, shielded-arc welding methods for faster welds and pressure tight joints.

Development of 5086 by Kaiser Aluminum makes possible many new applications of light weight, durable aluminum for the chemical and petroleum industries. Find out now how this versatile alloy can serve you.

For complete information, call the Kaiser Aluminum sales office listed in your phone directory. Process Industries Department, Kaiser Aluminum & Chemical Sales, Inc., *General Sales Office*, Palmolive Bldg., Chicago 11, Illinois; *Executive Office*, Kaiser Bldg., Oakland 12, California.

PHYSICAL CHARACTERISTICS OF ALLOY 5086

Typical mechanical properties in various tempers

	Temper			
	"0"	H32	H34	H112
Tensile strength (psi)	38,000	42,000	47,000	39,000
Yield strength (psi)	17,000	30,000	37,000	19,000
Elongation (% in 2")	22	12	10	14

Allowable design stress values

	For metal temperature not exceeding deg. F.	
Condition (temper)	100°	150°
Annealed	8700 psi	8700 psi
H112	8700	8700
H32	10,000	9900
H34	11,000	10,800

Allowable stress values for welded construction compared with other alloys

Alloy Designation		For metal temperature not exceeding 150° F. (annealed condition)
AA	ASTM	
1160	996A	1650 psi
1100	990A	2350
3003	M1A	3150
3004	MG11A	5650
5050	G1A	4000
5052	GR20A	6250
5154	GR40A	7350
5086	GM40A	8700

Nominal composition

4.0% magnesium
0.45% manganese
0.10% chromium

Typical weld strengths (specimens tested across the weld)

37,000 psi tensile strength
18,000 psi yield strength
13% elongation

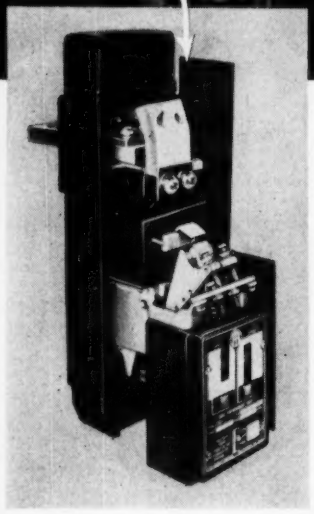
Kaiser aluminum 5086 is available in flat and coiled sheet, plate and extrusions.

Kaiser Aluminum

materials for the process industries

See "THE KAISER ALUMINUM HOUR." Alternate Tuesdays, NBC Network. Consult your local TV listing.

LOW VOLTAGE SWITCHGEAR



Here's SENSITIVE Circuit Protection

Some temporary overcurrents are tolerable; should even be permitted to occur. But sensitive circuit protection is needed to interrupt them when they persist too long or are of too high a magnitude.

The I-T-E Type OD-1 dual magnetic overcurrent trip device gives such protection. It permits temporary overcurrents, but limits them in duration and magnitude. This device will trip the circuit breaker after a predetermined interval on relatively low overcurrents or will trip instantaneously on high-magnitude fault currents. In either case you get safe, positive protection—sensitive to the needs of the circuit and the equipment on it.

For complete information on sensitive circuit protection, including selective tripping, undervoltage and other tripping devices, contact your local I-T-E sales representative. Or write for Bulletin 6004B. I-T-E Circuit Breaker Company, 19th & Hamilton Sts., Philadelphia 30, Pa.

Features of the I-T-E Type OD-1 Trip Device

PRECISION BUILT and factory calibrated to provide the highest possible accuracy in operation.

SEALED SILICONE TIMING ELEMENT. No maintenance. No oil to handle, no level to maintain, no sludging.

QUIET. Resonant vibration dampeners prevent a-c noise and wear on parts.

COMPLETELY ADJUSTABLE IN SERVICE. The delay pickup is easily adjusted from 80 to 160% of the continuous current rating. The instantaneous pickup is adjustable from 500 to 1500% of the continuous current rating. The time delay is adjustable to any of three time delay bands—minimum, intermediate and maximum.

SAFE DEAD FRONT DESIGN. Insulated knobs permit safe adjustment on a *hot* circuit breaker.

DEPENDABLE impact tripping action. The *hammer blow* movement of the time delay armature at end of timing stroke gives positive operation.

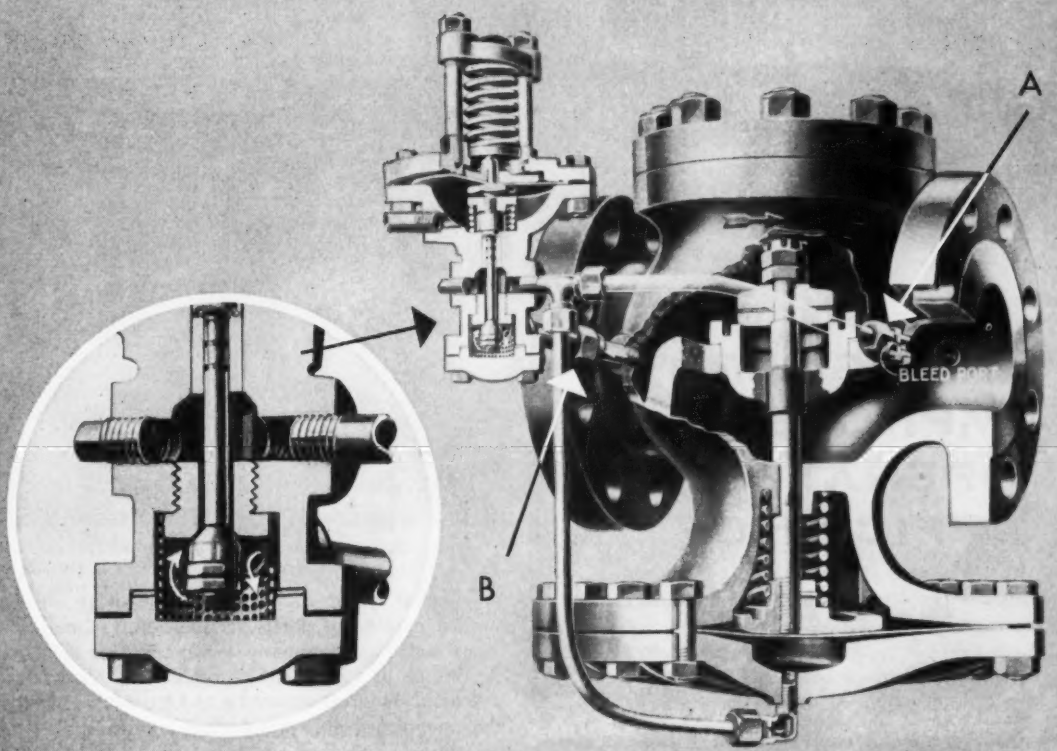
FAST RESETTING. Sensitive check valve on the piston provides quick resetting of the time delay. Repeat tripping is assured.

I-T-E CIRCUIT BREAKER COMPANY • Switchgear Division

IN CANADA: EASTERN POWER DEVICES, LTD.

VALVE TIPS:

Advantages of External Pilots in Automatic Regulating Valves



Spence Type ED Pressure Regulator

"Maintenance-free, trouble-free, install-and-forget." They're all pretty phrases, but every engineer knows from experience they don't apply to regulating valves. Any valve designed to control temperatures or pressures within tight limits can be affected by dirt or other foreign matter in steam lines.

One advantage of the external pilot mounting shown above is simplified maintenance. Trouble shooting is faster, downtime is reduced, and tempers don't take such a beating. Here's why:

If trouble develops, it's easy to find out if it's in the pilot or the main valve. Just remove the tubing bend at A. A simple test, without any instruments or other equipment, shows where the trouble is.

If the trouble is in the pilot, you can remove it by disconnecting the unions at B. There's no need to take the main valve out of the line.

The quickest way to get the regulator functioning again is to install a spare pilot. This is easy — and in the Spence design it's not expensive to carry spare pilots. Spence pilots fit all sizes of Spence main valves. There's no need to stock an expensive inventory of pilots for each main valve size.

In the enlarged sectional drawing above, you can see how the strainer, seat and disc of the pilot are readily accessible by removing the blind flange.

If the trouble is in the main valve, here again inspection is easy. If there's dirt in the steam line, it may clog the bleed port or restriction orifices. In the Spence design these can be inspected and cleaned by merely removing the tubing connections. The seat and disc of the main valve can also be inspected easily by removing the top flange.

These maintenance advantages, plus other advanced design features, are available for a wide range of regulating applications. For information on Spence's wide range of different automatic regulating valves, write for your copy of Bulletin 1005.

SPENCE ENGINEERING COMPANY, INC.
Walden, New York

In
POWER
STATIONS or
CARGO
SHIPS...

EDISON OMNIGUARD IMPROVES OPERATING EFFICIENCY

Whether you're seeking more production from electric power stations and plant equipment or greater safe speed from seagoing vessels, you will find Omniguard can help you get more efficiency from your present equipment.

Many operators are already using Omniguard, the unique temperature indicating and alarm system designed by Thomas A. Edison, Inc., as the best means of eliminating waste due to downtime, repairs and lost production.

Omniguard improves plant efficiency and lets you operate at peak capacity because it unfailingly reports when dangerous temperature conditions occur at one or more points. And does it at surprisingly low cost.

A modular system of monitoring one to an unlimited number of points simultaneously, Omniguard watches continuously. When a bearing starts heating up or a process becomes critically hot, it automatically gives a warning and/or shuts down the equipment before it is damaged.

The low cost unit is easy to install. It is non-electronic and simplifies installation and maintenance through the use of copper wiring between all components.

See for yourself. A personal demonstration can be arranged at your own plant. Take it apart. Analyze it. Find out how simply Omniguard improves operating efficiency. Just write!

Thomas A. Edison

A GREAT NAME CONTINUES GREAT NEW ACHIEVEMENTS

Thomas A. Edison

INCORPORATED

INSTRUMENT DIVISION • 41 LAKESIDE AVENUE • WEST ORANGE, NEW JERSEY

Get low-cost boiler feed from oil-bearing condensate...

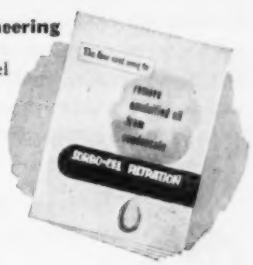
WITH SORBO-CEL FILTRATION

Sorbo-Cel filtration systems are compact . . . easy to operate with unskilled labor.

2¢—5¢ per 1000 gallons is all it costs you to reclaim oil-contaminated condensate with Sorbo-Cel® filtration. Sorbo-Cel can reduce oil content to less than 0.1 ppm . . . also removes rust, scale and other suspended solids. Sorbo-Cel not only saves water, but materially reduces boiler tube maintenance caused by oil and suspended solids in the feed water. And proper lubrication need not be sacrificed to insure oil-free water.

Sorbo-Cel is a diatomite powder specially processed to provide the most efficient and economical filtration of oil-contaminated water . . . for boiler feed or other process applications. It can be used with practically every type of pressure filter and requires no additional chemicals.

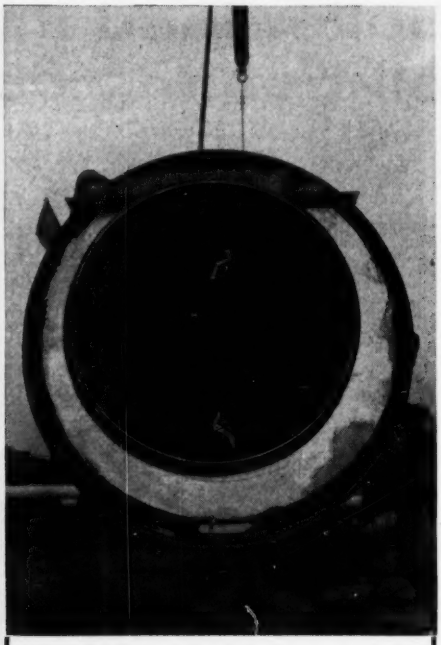
Free! Information and Engineering Service. Write today for your free copy of the new Sorbo-Cel brochure. If you desire, a Sorbo-Cel engineer will call for appointment to visit your plant. Address Johns-Manville, Box 14, New York 16, N.Y. In Canada, Port Credit, Ontario.



JOHNS MANVILLE JM PRODUCTS

Johns-Manville SORBO-CEL®

MORE STEAM FOR MANHATTAN...



NATIONAL SEAMLESS Pipe, 24-inch diameter, assembled in insulated shell.

24-inch USS NATIONAL SEAMLESS PIPE carries steam at 400 psig across heart of New York

THE TREND towards centralized air conditioning in New York's office buildings, hotels and new apartment houses in recent years has created a demand for increased steam service. Although Consolidated Edison Company's present facilities are adequate, it was felt that future requirements would be much greater in the downtown financial district. Thus, the need for more steam.

The most economical and practical method of expanding facilities was to run a high-pressure steam main from the company's East River Station—where steam could readily be made available—to the present downtown Manhattan Burling Slip Station.

To meet the immediate and anticipated demands of Manhattan, a main of NATIONAL SEAMLESS Pipe, 24-inch in diameter, operating at 400 psig and 500°F., was installed. About 14,000 feet of NATIONAL SEAMLESS were used in the installation.

It's no surprise that NATIONAL SEAMLESS was specified for this installation, since grueling service like this calls for the very best in piping. USS NATIONAL SEAMLESS has never been surpassed for power service, even under the most severe operating conditions. Pierced from solid billets of steel, NATIONAL SEAMLESS Pipe and Tubes have the strength, uniformity, and dependability of solid forgings. They remain structurally sound under high temperatures and intense pressures.

For more information concerning USS NATIONAL SEAMLESS Pipe, write to National Tube Division, United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pa.

NATIONAL TUBE DIVISION, UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.

COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS • UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS

NATIONAL Seamless PIPE AND TUBES

SEAMLESS WALLS WITHOUT WELDS

UNITED STATES STEEL

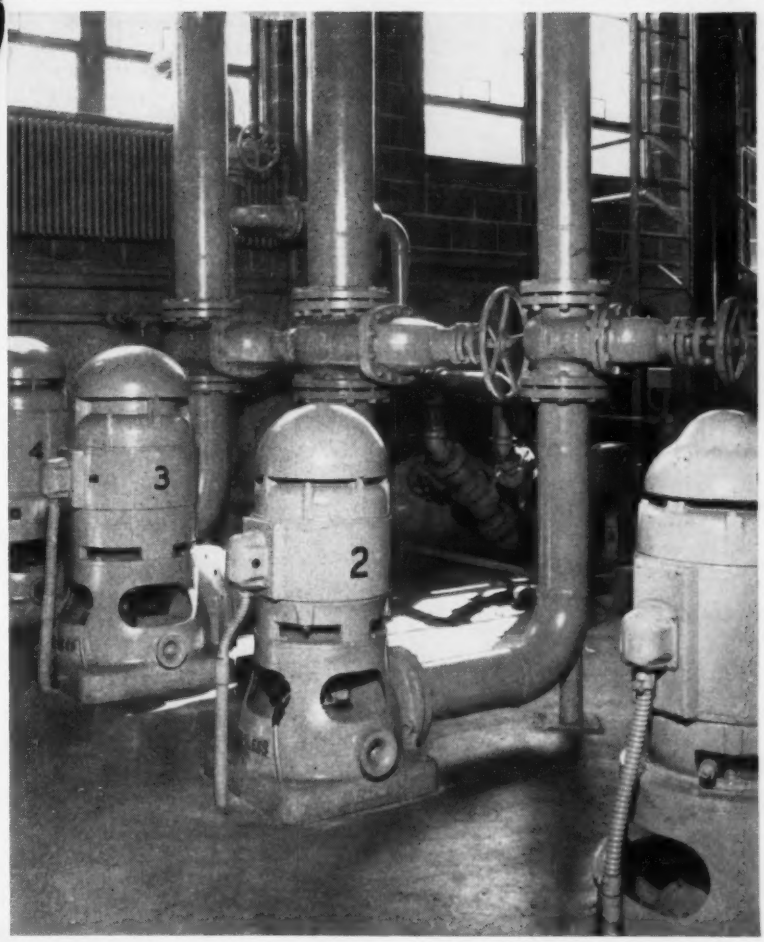
Vertical Versatility

IN PUMPING LIQUIDS FROM SHORT SETTINGS

PEERLESS PUMPS

PEERLESS INDUSTRIAL SERVICE PUMPS

3 PRODUCTION DESIGNS . . . Standard, Heavy-Duty and Special Service Types Provide Widest Flexibility in Application



Single and Multi-Stage Units Available Engineered to the Individual Application

Advantages and Features of the Peerless Vertical Industrial Service Pump

→ **SAVES ON PIPING**—Eliminates suction piping.

→ **ALWAYS PRIMED**—Once installed, always primed.

→ **SPACE SAVING**—Requires minimum floor space.

→ **ALL TYPES OF DRIVES**—Leading makes of electric hollowshaft and solid shaft motors; right angle gear drives; vertical and horizontal steam turbines.

→ **IMPROVED SUCTION**—New bell mouth suction manifold immeasurably improves water entrance conditions.

→ **HIGHEST EFFICIENCIES**—Peerless advanced vertical turbine design records highest in pump efficiencies.

→ **FLEXIBILITY**—Easiest to adapt to future system needs.

→ **COMPLETE LINE**—Peerless makes available broadest range of vertical turbine pump capacities, head conditions and horsepowers offered by any manufacturer. Capacities: 30 gpm to 40,000 gpm. Heads: up to 1000 feet. Electric drive up to 2500 hp.

NEW BULLETIN—FREE! JUST FILL OUT COUPON AND MAIL TODAY

New 16-page bulletin is profusely illustrated, describing completely all 3 Peerless types. Contains new engineering data on sump designs, etc. Write today for your copy.

PEERLESS PUMP DIVISION
Food Machinery and Chemical Corporation
Address inquiries to Factories at:
Los Angeles 31, Calif.; Indianapolis 8, Ind.
Offices: New York, Indianapolis, Chicago, St. Louis, Atlanta, Dallas, Plainview, and Lubbock, Texas; Fresno, Los Angeles, San Francisco, Phoenix, Albuquerque.
Distributors in Principal Cities:
Consult your Telephone Directory.

PEERLESS PUMPS
fmc

PEERLESS PUMP DIVISION
Food Machinery and Chemical Corporation
301 West Avenue 26
Los Angeles 31, California

Please send copy of Industrial Service Pump Bulletin No. 505

NAME_____

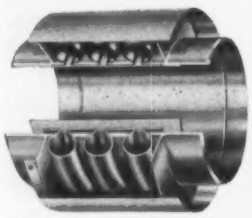
COMPANY_____

STREET_____

CITY_____ STATE_____

POW

NEW ZALLEA HyPTor* TOROIDAL EXPANSION JOINT



HyPTor corrugations have a circular or toroidal cross section which provides a lower operating stress at any given pressure than any other corrugation shape.

For unequalled endurance at pressure and temperature extremes

This unique toroidal expansion joint with thin-walled bellows is setting new performance and durability records in high pressure, high temperature service. It was developed to meet the severest operating conditions without sacrificing long life.

Minimum stress at high pressures is one advantage of the Zallea HyPTor. This is due to the thin-walled bellows and toroidal corrugations. Thin walls develop lowest flexing stress. The toroidal cross section assures lower operating stress at any pressure.

Superior performance at high temperatures. The toroidal corrugation of the HyPTor makes it suitable for use at high temperatures. Also, the HyPTor is hydraulically formed and free from circumferential welds which would act as stress raisers.

Longer life on the job. The ability of the HyPTor to absorb punishment without ill effects has been proved in service. A number of HyPTor Expansion Joints designed for 700 psi working pressure, were installed in liquid oxygen service in 1948. They are still operating . . . at pressures up to 2300 psi.

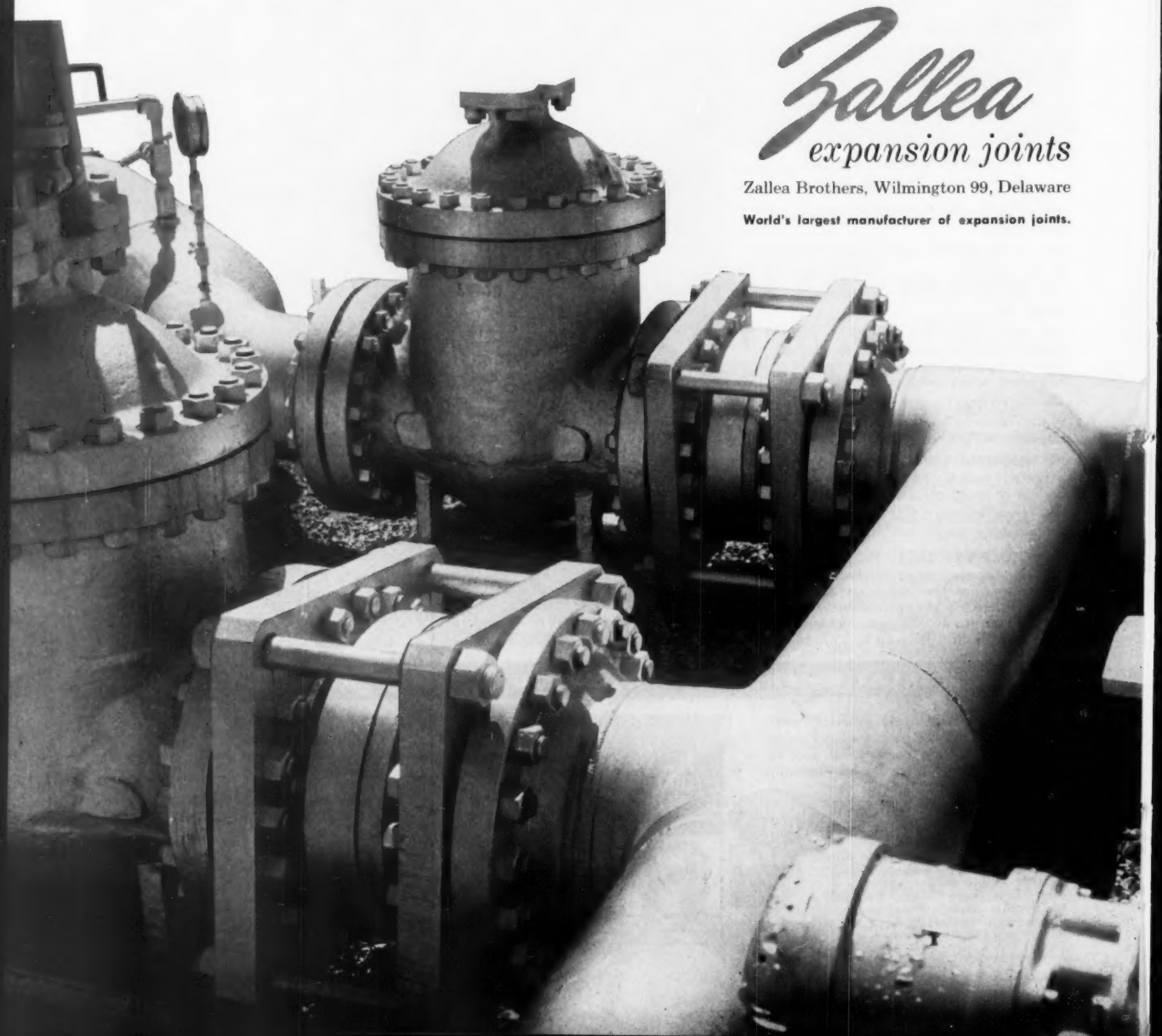
Get the complete story of the new Zallea HyPTor Expansion Joints. Our new 72-page Expansion Joint Manual gives full details—plus worthwhile information on basic types, design and installation data, expansion joint selection and recommended specifications. Write on your Company letterhead, for your free copy of Catalog 56, Zallea Brothers, 890 Locust Street, Wilmington 99, Delaware.

*Patented

Zallea
expansion joints

Zallea Brothers, Wilmington 99, Delaware

World's largest manufacturer of expansion joints.



Unretouched photo showing typical return line corrosive action resulting from carbonic acid and dissolved oxygen in condensate.

BREAKING DOWN WITHIN

This section of pipe looks like new—on the outside. But take a look inside. Grooving action caused by carbonic acid and deep pitting, the result of dissolved oxygen attack, have almost completely penetrated the pipe wall.

Dearborn FILMEEN* prevents such destruction. FILMEEN forms a protective, non-wettable barrier between treated steam, or condensate, and metal pipe surfaces. By preventing the carbonic acid and dissolved oxygen from coming into contact with the metal, FILMEEN assures corrosion-free lines. FILMEEN is only one of many Dearborn water conditioning products scientifically developed to control specific corrosion problems. Others eliminate scale, sludge, carry-over and similar difficulties.

Power engineers in leading industrial and commercial plants place their confidence in Dearborn's 70 years of experience in water chemistry. They have found the answer to the demand for complete plant protection in Dearborn Supervisory Service—a properly balanced water conditioning program which combines quality products with correct, technically supervised control methods and test procedures.

Let a Dearborn Engineer survey your plant and recommend the type of water control program best suited to your requirements.

**FILMEEN is the trade-mark of a corrosion-inhibiting compound patented and produced exclusively by Dearborn Chemical Company. U.S. Pat. No. RE 23614.*

Dearborn®

...a leader in water conditioning and corrosion control for 70 years

Dearborn Chemical Company
Merchandise Mart Plaza, Dept. PO, Chicago 54, Ill.

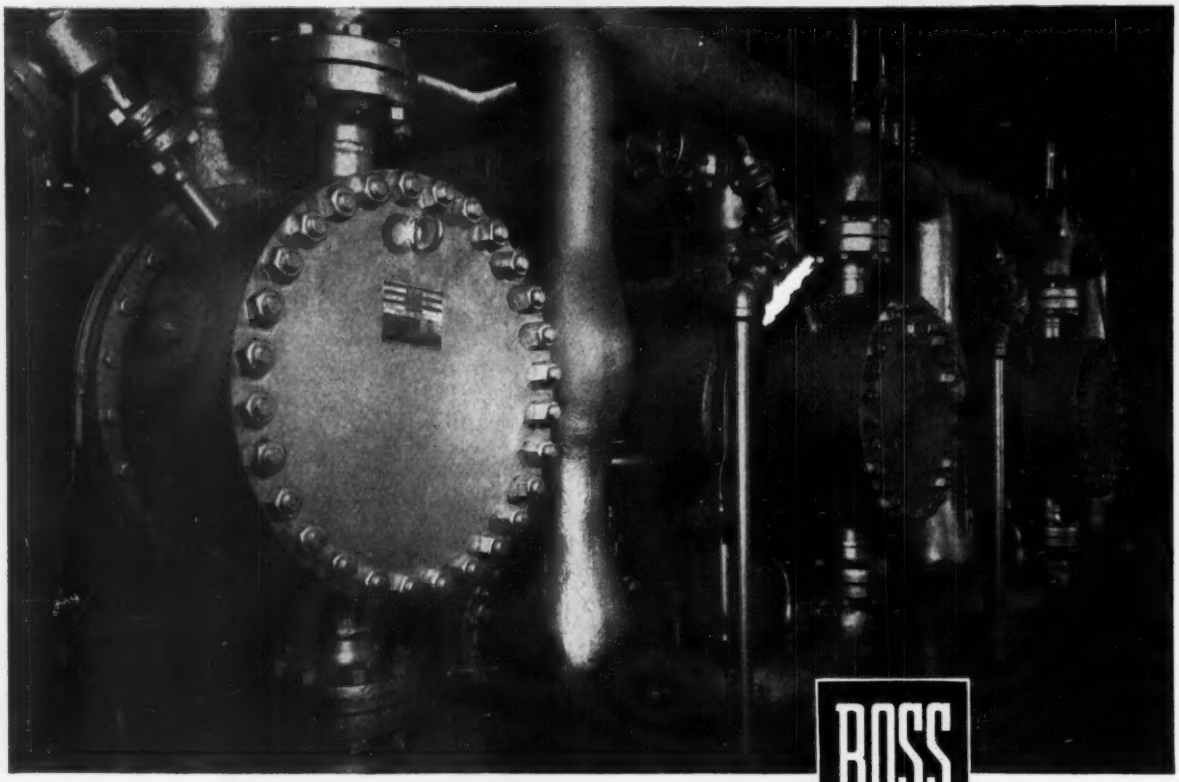
Gentlemen: ☐ Have a Dearborn Water Conditioning Engineer call.
☐ Send me complete information on Dearborn Water Conditioning Program.

Name.....*Title*.....

Company.....

Address.....

City.....*Zone*.....*State*.....



THE ROSS STORY

Special Heat Exchange Equipment for Power Plants

Simply stated, Ross designs and manufactures heat exchangers for virtually all conditions and applications, particularly units of a highly specialized nature, such as high pressure power plant equipment... bleeder heaters and fuel oil heaters, for example.

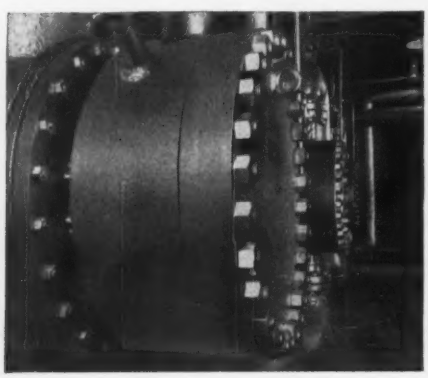
The installation of 6 Ross High Pressure Fuel Oil Heaters (illustrated) at the Pacific Gas and Electric Co.'s Station P Steam Plant in San Francisco is typical. Featuring forged oil channels with integral tube sheets and a double tube sheet arrangement to insure against any possibility of fuel oil contaminating the steam system, these rugged units demonstrate Ross' resourcefulness and experience in dealing with both the average and the specialized power engineering problem.

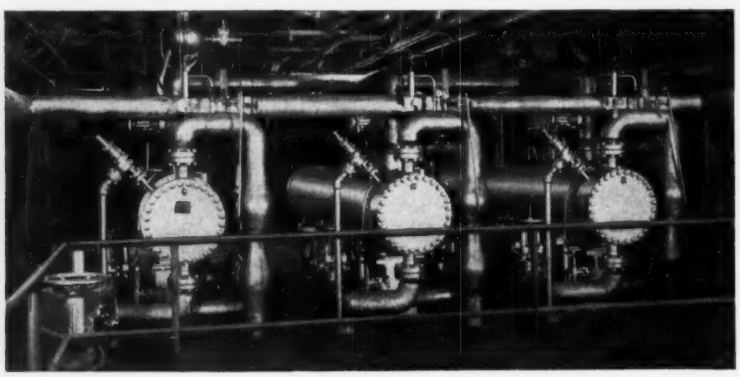
Your requirements, too, can be met with the same, exacting Ross attention to details. Inquire now. Ross offices are in all principal cities.

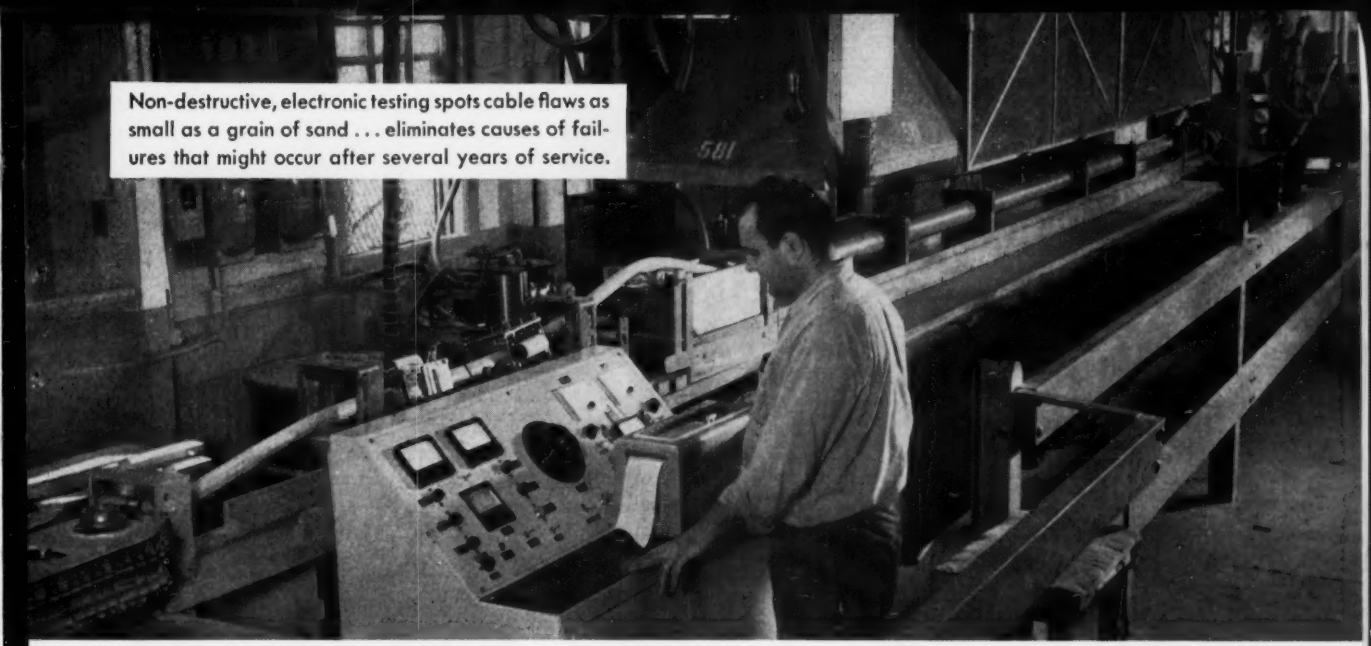
For recommendations on specialized heat exchangers, as well as on surface condensers, turbine oil coolers, engine oil and water coolers, compressor inter and after coolers and related power plant equipment, you'll profit by consulting a Ross engineer.

ROSS HEAT EXCHANGER

Division of AMERICAN-Standard







Non-destructive, electronic testing spots cable flaws as small as a grain of sand . . . eliminates causes of failures that might occur after several years of service.

now all Okonite rubber strip-insulated cables rated above 2kv undergo the most searching test in the industry

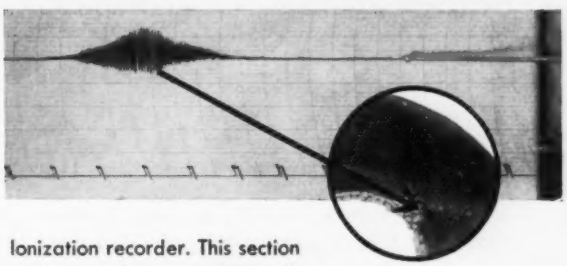
The Gooding Test Train, an Okonite development, can literally peer through every inch of solid dielectric cable to pinpoint flaws for removal or correction.

Two years' experience in regular production has proved that the Gooding Test Train detects flaws heretofore unrevealed even by the highest industry voltage tests or full-reel corona tests. Now that this valuable method of quality control has been thoroughly established, Okonite has extended its testing range to all strip-insulated cables rated above 2kv.

The entire cable passes through a series of three test units which provide unequalled assurance of successful service. The Gooding Test Train is used on strip-insulated cables in addition to Okonite's self-imposed, factory high-voltage acceptance tests which exceed industry specifications.

UNIFORMITY TEST—A uniformity gauge continuously checks insulation thickness to locate any thin spots.

IONIZATION TEST—The tiniest voids and imperfections are detected and located by measuring the corona level of the cable inch-by-inch. To pass, a cable must not show any trace of corona at a test voltage that is 1½ times the rated voltage of the cable. Defects that might escape any other known factory acceptance tests show up clearly on the associated ionization recorder. Defects of this kind can cause premature failure after only a few months' or years' service.



Ionization recorder. This section of the continuous inch-by-inch ionization test shows the recording of a defect in the insulation.

X-RAY TEST—A 250,000-volt X-ray machine can be used to study the nature and extent of any flaws located by the first two units.

For additional information about this revolutionary testing method, write for Bulletin PW -1100. The Okonite Company, Passaic, N. J.

4702

where there's electrical power... there's **OKONITE CABLE**

The Case of WASTED HORSEPOWER

or

"Over-motoring" is outmoded by Dow Corning Silicones

SCENE: Pump room, Anyplant, U. S. A.

CHARACTERS: TINY H.—a 5 hp Class H motor insulated with Dow Corning Silicones.
BLUSTER A. — a 7½ hp Class A motor.

TINY H: You're goofing-off again! Why don't you try moving a bigger load now and then?

BLUSTER A: Nuts to you, Tiny. I'm working hard enough keeping this little pump going.

TINY H: But you're strong enough to drive a bigger pump . . . or are you?

BLUSTER A: That's enough. I should worry—the engineers who put me here figured I might have to carry a 6 hp load—er—once in a while, at least.

TINY H: Sooo what! I'm rated to match our average load. My silicone insulated innards give me extra muscles to carry any overloads. Why—I could pump a 7 hp load and still be here when you're dead and gone.

BLUSTER A: Shut up, Tiny! Somebody might hear you.

TINY H: Okay, fat stuff, but you can't hide the facts forever. Mark my nameplate—one of these days the boss will figure out how much money you're wasting and you'll have had it.

You can match the load . . .
let Silicones carry the overload

Lazy motors cost money! Why continue to pay a fat premium for motors that make kid's play of their average work load? Today, you can save money by using silicone insulated motors rated to match your average load. Their built-in service factor of 25 to 50% will handle most intermittent overloads or loads that can't be matched in standard frame sizes.

Remember, over-motoring is outmoded

Get sources for silicone insulated equipment—mail coupon today

Dow Corning Corporation, Dept. 6916, Midland, Mich.

Please send me sources of supply for new Silicone (Class H) ☐ Motors ☐ Transformers

NAME _____ TITLE _____

COMPANY _____

STREET _____

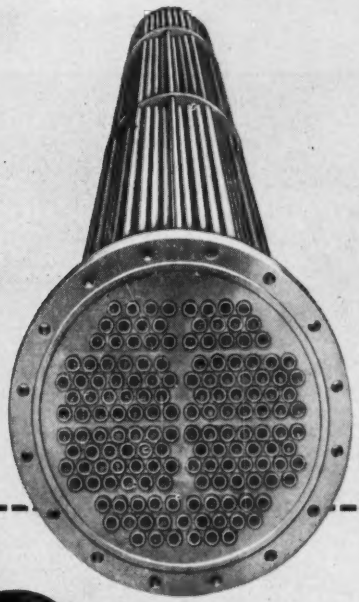
CITY _____ ZONE ____ STATE _____

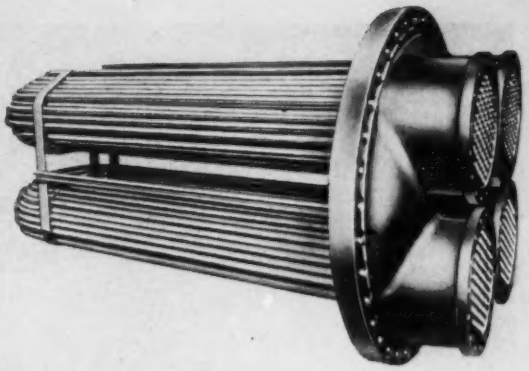
DOW CORNING SILICONES

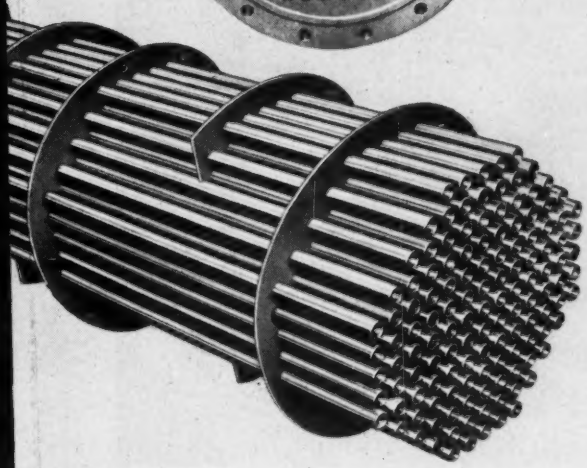
DOW CORNING CORPORATION
MIDLAND, MICHIGAN

ATLANTA • BOSTON • CHICAGO • CLEVELAND • DALLAS
DETROIT • LOS ANGELES • NEW YORK • WASHINGTON, D. C.
(Silver Spring, Md.)

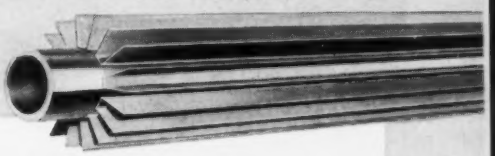
CANADA: Dow Corning Silicones Ltd., Toronto
GREAT BRITAIN: Midland Silicones Ltd., London
FRANCE: St. Gobain, Paris





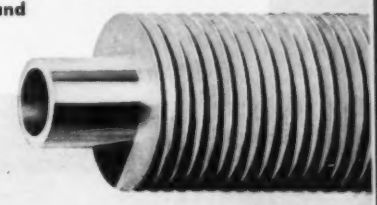


TWO GOOD WAYS TO ADD ADDITIONAL HEAT TRANSFER SURFACE AREA TO B&W CARBON STEEL ERW TUBES



(A) Longitudinal Channels Welded On

(B) Continuous Helical Fin Wound Around Tube and Welded On



TUBING REQUIREMENTS FOR HEAT TRANSFER EQUIPMENT

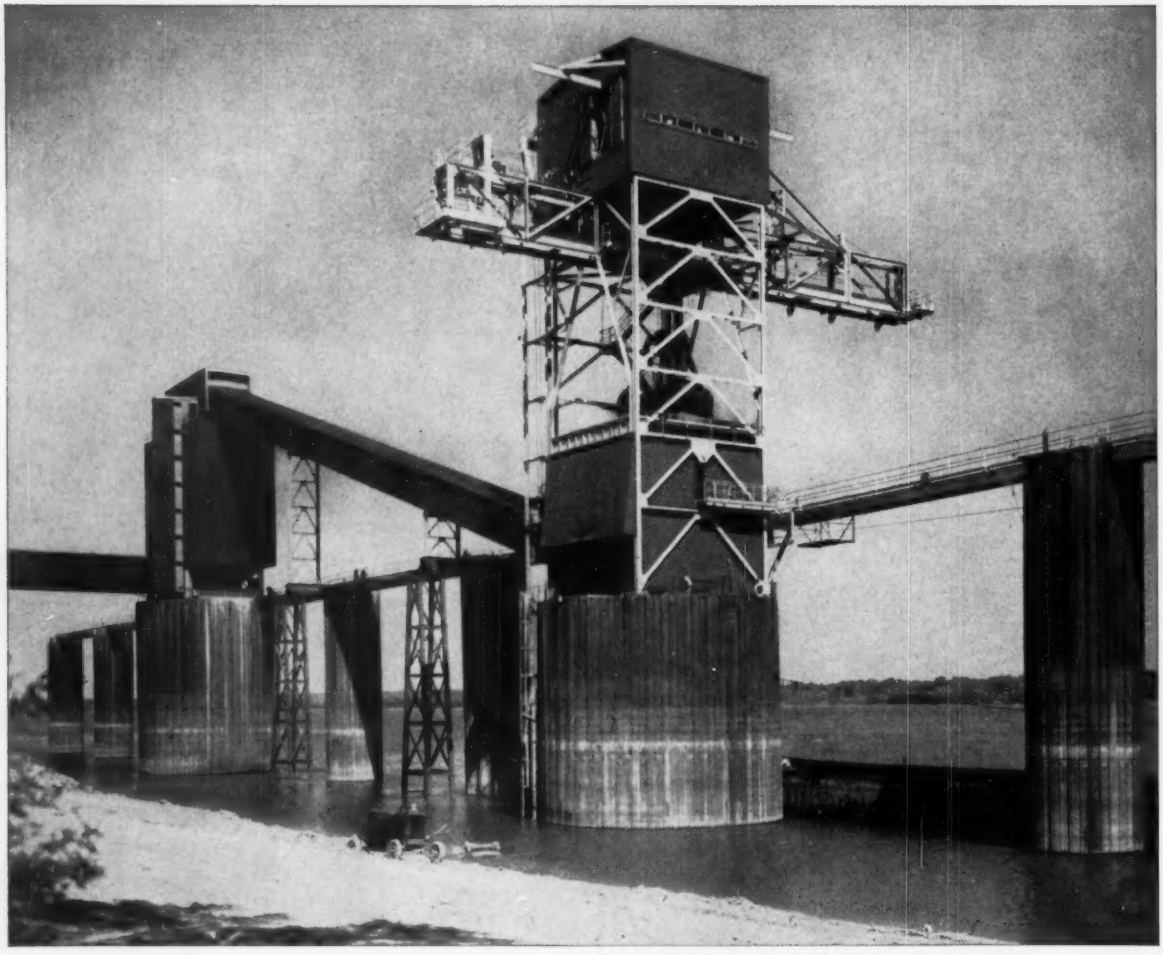
The economy and usefulness of pressure tubing in heat exchanger and condenser applications depend on the tubing's heat transfer ability and the ease with which it can be bent, coiled, swaged, and rolled into tube sheets.

Because of its uniform wall thickness, the heat transfer ability of B&W Electric-Resistance-Welded Carbon Steel Tubing is the optimum for such a ferrous material. It is an economical material to use, not only because of its reasonable first cost, but also because of its low fabrication cost, since ease of bending, coiling, swaging, and rolling into tube sheets is provided through quality-controlled methods used in its manufacture.

B&W Electric-Resistance-Welded Carbon Steel Heat Exchanger and Condenser Tubing is widely used in the process industries, including petroleum refining and chemical processing, and in refrigeration and steam generating equipment. If carbon steel tubing can do the job required, you will find B&W ERW Tubing provides maximum, trouble-free service life. For additional information, call on Mr. Tubes, your nearby B&W Tube Representative — *or write for Bulletin 412.* The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pa.

TA 6099 PG-2

Seamless and welded tubular products, seamless welding fittings and forged steel flanges—in carbon, alloy, and stainless steels



9-ton coal unloader, with free digging capacity of 850 tons per hour, has an average operating lift of 75 feet and travel distance of 40 feet.

Barge unloading?...WE DO THE COMPLETE JOB— unloading tower, dock and all auxiliaries

Dravo experience in the design and construction of complete bulk materials handling installations can help you lower coal handling costs materially. Take the facility shown above. The cellular steel sheet pile dock requires no maintenance, provides safe mooring for barges and supports the barge shifters, other auxiliaries and the unloading tower.

This all-welded tower has a single hoist motor and drum which perform all hoisting and lowering operations. Hoisting rope pull is equalized, and a counterweight reduces hoisting horsepower. A separate drive provides independent and positive bucket closing.

Dravo facilities provide for the design, fabrication and erection of the complete job. Tower, dock and auxiliaries are integrated into a smooth-running installation designed to operate at maximum efficiency and low cost.

Dravo heavy materials handling equipment is at work in power plants, steel mills, port docks and other materials transfer points. You can learn about Dravo's complete line of trolleys, bridges, towers and other related equipment by writing for Bulletin #225. Better still, let us arrange for your visit to actual installations. Simply call us at Pittsburgh, Spalding 1-1200, or write DRAVO CORPORATION, PITTSBURGH 25, PENNSYLVANIA.

DRAVO
CORPORATION

Blast furnace blowers • boiler and power plants • bridge sub-structures • cab conditioners • docks and unloaders • dredging • fabricated piping foundations • gantry and floating cranes • gas and oil pumping stations • locks and dams • ore and coal bridges • process equipment • pumphouses and intakes • river sand and gravel • sintering plants • slopes, shafts, tunnels • space heaters • steel grating • towboats, barges, river transportation

why wonder?

You can be sure you're getting a ready-to-go steam trap when you buy a Nicholson . . . because each and every one is tested in actual steam service before shipment.

And that's not all. With just one thermostatically-operated moving part, there's nothing to get out of order, nothing to go wrong. Nicholson means continuous operation of your steam-using equipment . . . no downtime from trap failure.

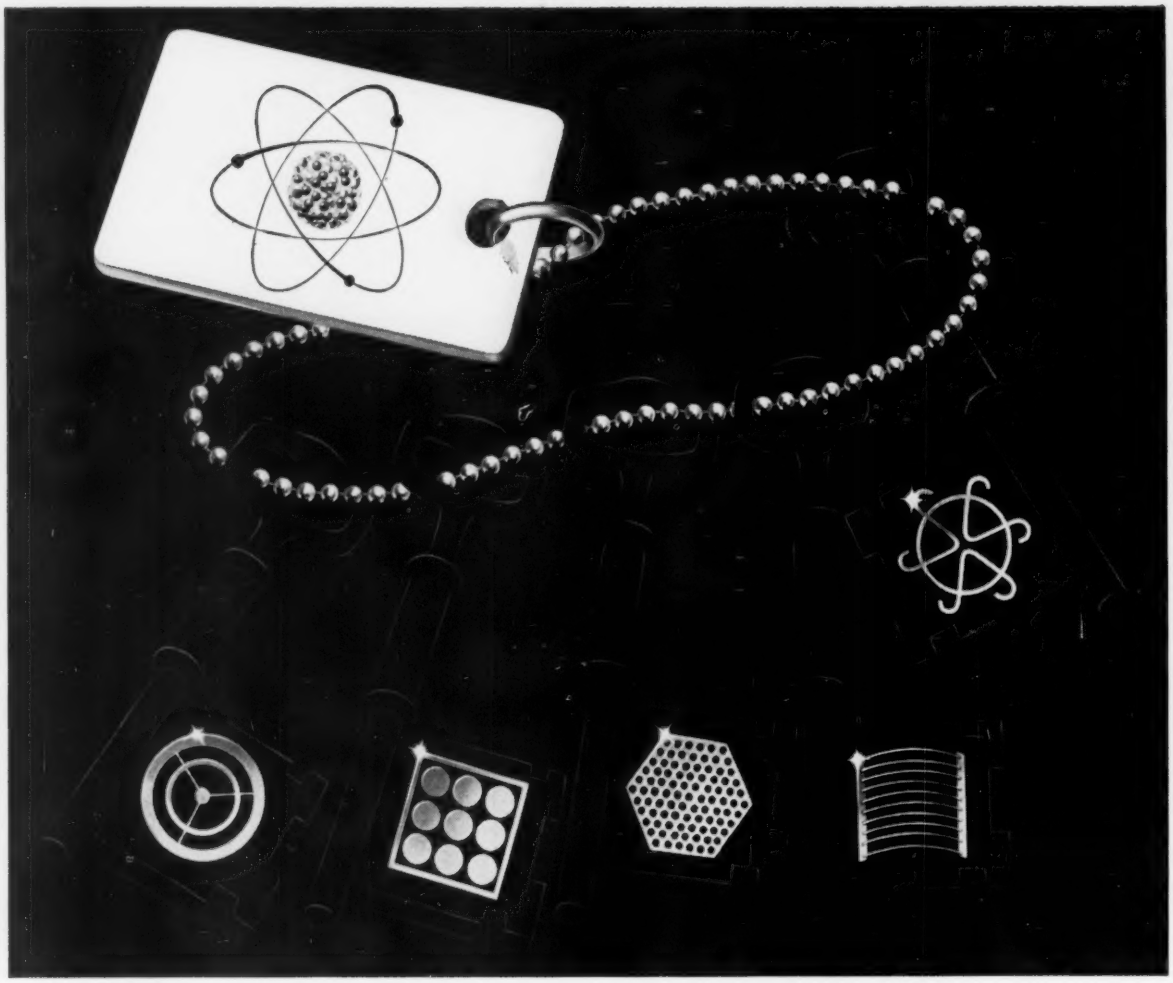
- **high air-venting capacity . . . for faster warmup of equipment.**
- **powerful valve action . . . no mechanical linkages to cause trouble.**
- **small and lightweight . . . easy to pipe and support.**

So, to get a trap that's service-tested, and loaded with operating features, specify Nicholson. W. H. NICHOLSON AND COMPANY, 14 OREGON ST., WILKES-BARRE, PA., *Sales and Engineering offices in 98 principal cities.*

Write for Bulletin 1055

NICHOLSON

of Wilkes-Barre



Which is the key to economical nuclear power?

In any reactor, economical power production depends a great deal upon the design, composition and construction of the fuel element itself. Shape, size, mechanical structure and degree of enrichment all play a part in the extraction of maximum energy with minimum fuel cost.

Sylvania was a pioneer in the development of efficient reactor fuel elements and practical reprocessing techniques. During more than eight years of successful experience in solving advanced technical problems in atomic energy, Sylvania has built up a unique and highly specialized research organization. Staffed with top-ranking scientists and engineers, working in well-equipped laboratories, Sylvania carries on a constant program of reactor fuel research in four basic fields: materials development, fabrication development, test methods development and prototype model production.

Particular stress is laid upon the development of test methods—both in and out of reactor. For only by means of satisfactory test methods can new designs and materials be evaluated. To this end, Sylvania has perfected a number of unique methods of reliable projective evaluation.

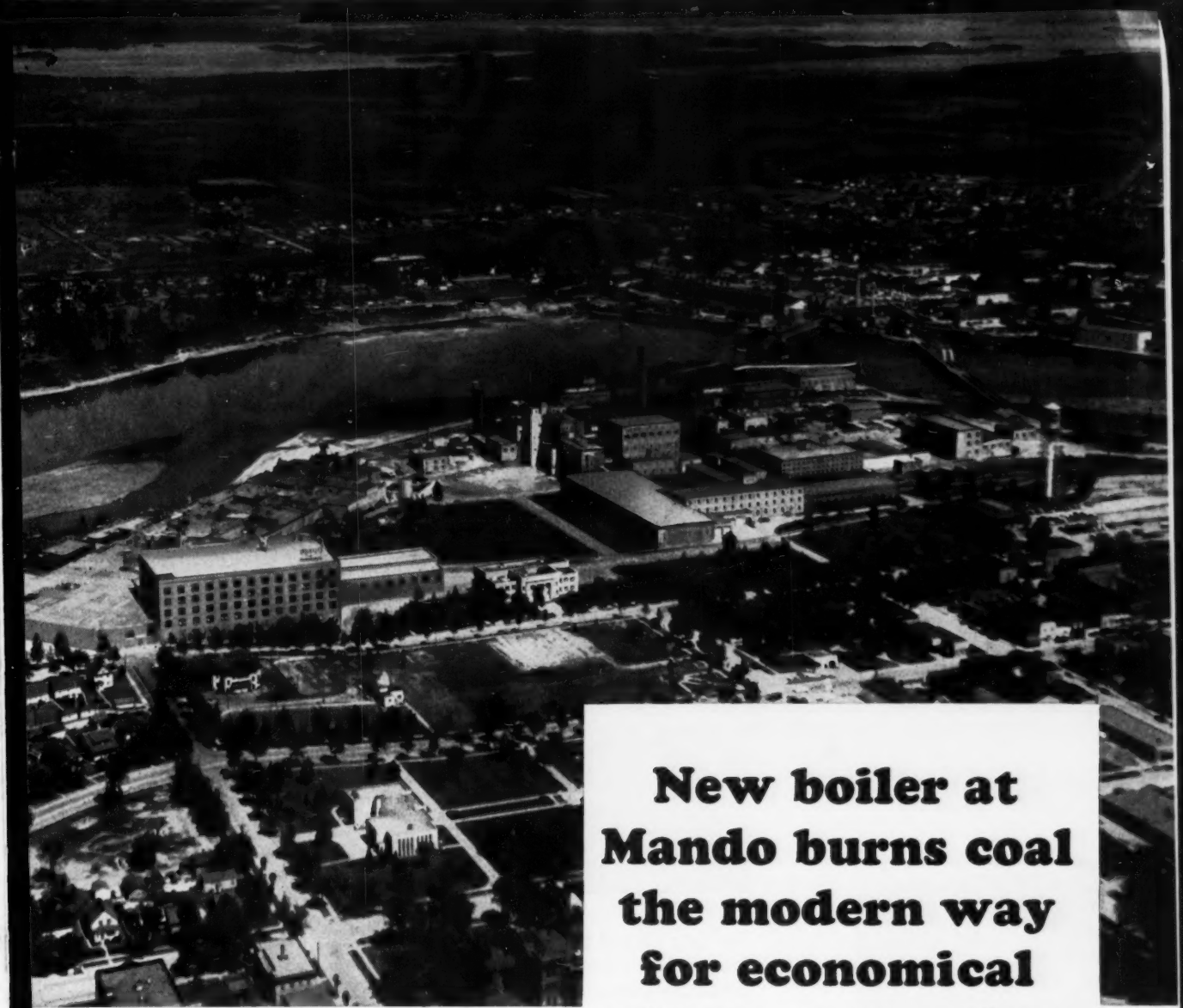
If you are wondering which type of element will prove most effective in your own reactor, we will be glad to make recommendations on the basis of our long and specialized experience in nuclear fuels. Write for a booklet on Sylvania Nuclear Fuel Elements.

SYLVANIA ELECTRIC PRODUCTS INC.
Atomic Energy Division, Bayside, New York
In Canada: Sylvania Electric (Canada) Ltd.,
Shell Tower Building, Montreal
Sylvania International Corporation,
22 Bahnhofstrasse, Coire, Switzerland.

SYLVANIA

ATOMIC ENERGY DIVISION

LIGHTING • RADIO ELECTRONICS TELEVISION • ATOMIC ENERGY



New boiler at Mando burns coal the modern way for economical steam generation

Consult an engineering firm

Designing and building hundreds of heating and power installations a year, qualified engineering firms can bring you the latest knowledge of fuel costs and equipment. If you are planning the construction of new heating or power facilities—or the remodeling of an existing installation—one of these concerns will work closely with your own engineering department to effect substantial savings not only in efficiency but in fuel economy over the years.

facts you should know about coal

In most industrial areas, bituminous coal is the lowest-cost fuel available • Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar • Automatic coal and ash handling systems can cut your labor cost to a minimum. Coal is the safest fuel to store and use • No smoke or dust problems when coal is burned with modern equipment • Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.

Mando—the Minnesota and Ontario Paper Co.—is keeping pace with continuing production expansion. The firm recently installed in its plant at International Falls, Minn., one of the largest modern single-pass boilers in the pulp and paper industry. It is designed to produce 240,000 lbs. of steam an hour, bringing the mill's steam generating capacity to 960,000 lbs./hr. The new boiler has 22,500 sq. ft. of heating surface and required 300,000 lbs. of steel in its construction. It will use 775,000 gallons of water a day and, for economy, will burn pulverized coal as a primary fuel—300 tons daily!

For further information or additional case histories showing how other plants have saved money burning coal, write to the address below.

BITUMINOUS COAL INSTITUTE
Southern Building • Washington 5, D. C.

You can't buy a better flange...

Forged Steel. Shot Blasted. All Phoenix flanges meet full A.S.A. specifications — carbon steel and alloy.

Spot faced bolting surfaces, extra fine facings, accurate threading and a protective coating are typical of Phoenix quality.

Precisely machined welding bevel.

Special facings, bores, drilling, threading and special machining available.

The long life and precision workmanship you have a right to expect in the flanges you buy are assured when you order Phoenix forged steel flanges. You simply can't buy a better flange! It costs no more for Phoenix quality and *service*. That's why it's always worthwhile discussing your pipe flange requirements with the Phoenix representative.

A serrated gasket surface finish is standard on all Phoenix flanges with raised facings.

Write for handy 36 page pocket-size reference booklet containing useful data on flanges. It's FREE!

Leading Manufacturers of Pipe and Tank Flanges and Commercial Forgings

PHOENIX

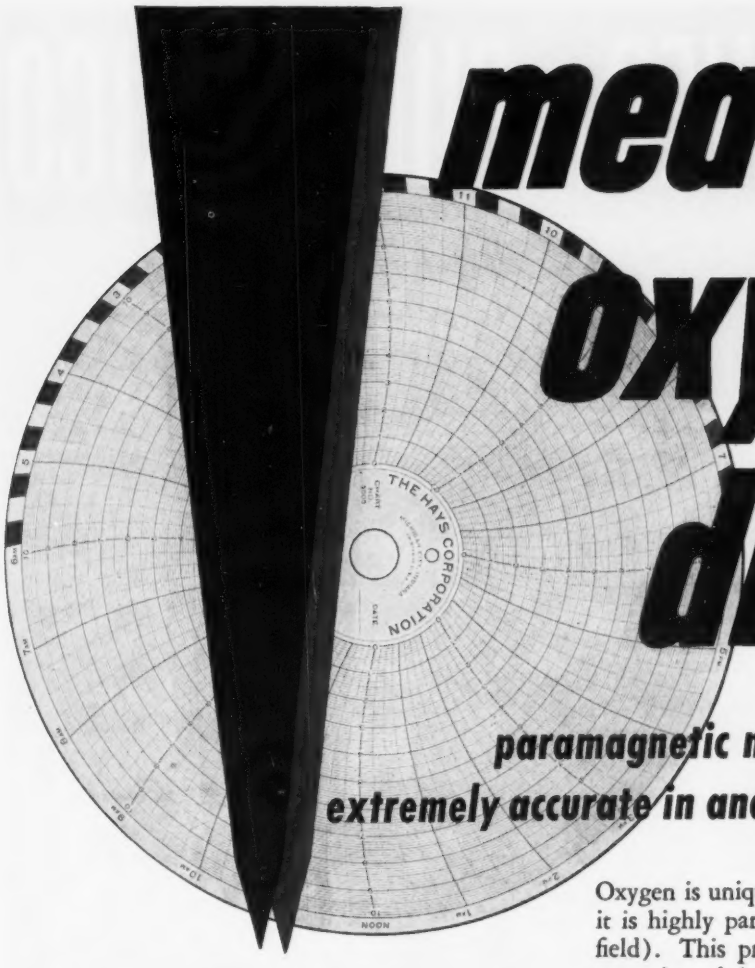
FLANGE AND FORGING DIVISION

PHOENIX MANUFACTURING COMPANY

CATASAUQUA, PA. · JOLIET, ILL. · FOUNDED 1862

Integrated Manufacturing Facilities: FLANGE AND FORGING DIVISION, STEEL MILL DIVISION, HORSESHOE PRODUCTS DIVISION, RUBBER PRODUCTS DIVISION, OIL AND GREASE SEAL DIVISION

measure oxygen direct



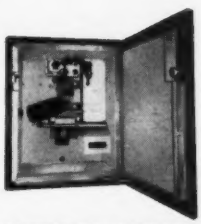
paramagnetic method of measurement extremely accurate in analyzing industrial gases

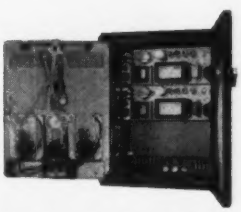
Oxygen is unique among other common gases in that it is highly paramagnetic (attracted into a magnetic field). This property of oxygen is the basis of the operation of the Hays Magno-Therm Analyzer in the analysis of industrial gases.

application

Hundreds of companies are using the Hays Magno-Therm O_2 Analyzer and Recorder in applications from revivification of SO_2 removers in manufactured gas industry and regeneration of catalysts in oil refineries to mixing air with propane to get substitute fuel. Boiler plants use it as a combustion guide because it is the only means of getting an undistorted picture of excess air.

Write today for bulletin 52-829-56 and get complete details.





ANALYZER	RECORDER
Highly sensitive to changes in oxygen content.	Self-balancing bridge circuit assures accurate, permanent calibration.
Rapid response to changes in oxygen content.	Electronic amplifier has no moving parts. High sensitivity. Rugged.
No liquid or gaseous fuel required to be added to gas sample.	Immediate response—analyzer is continuously connected to recording pen drive motor.
No chemicals required.	As many as four analyses can be recorded on the same chart.
High accuracy maintained.	Range can be changed easily in the field.
Not affected by wide variation in rate of flow of gas sample.	Isolating transformer for each amplifier removes line interference from bridge circuit.
Rugged construction. No delicate or moving parts.	Extra slide wire available for control, remote indication—for recorder or contacts for alarm circuit.
Easily installed — no special fittings required.	

Automatic Combustion Control Boiler Panels • CO_2 Recorders Veriflow Meters and Veritrol Gas Analyzers • Draft Gages Combustion Test Sets Electronic Oxygen Recorders Electronic Flowmeters Electronic Feed Water Controls Miniature Remote Indicators

THE hays CORPORATION

MICHIGAN CITY, 3, INDIANA

MORE POWER for PUERTO RICO

with two 20,000 kW

BROWN BOVERI GAS TURBINES

Puerto Rico is Growing!

To take care of the vastly increased power demands on the Island, the Puerto Rico Water Resources Authority has ordered two 20,000 kW Brown Boveri Gas Turbines to handle the very predominant daily peak load.

Fast starting, a characteristic of these turbines (on the line in 20 minutes or less from cold start) makes them ideal for peak load operation. . . Their proven design is based on many years of operating experience of similar and larger units... All this is assurance that Puerto Rico will get dependable, trouble-free service from the equipment.

Find out how Brown Boveri can solve your peak load problems. Write for more information, today!

A Brown Boveri Gas Turbine installation similar to the two 20,000 kW turbines to be installed in Mayaguez, Puerto Rico.

BROWN BOVERI CORPORATION

19 RECTOR STREET • NEW YORK 6, N. Y.

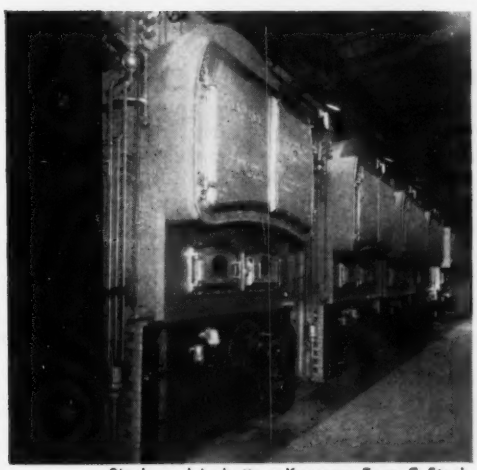
BROWN BOVERI

Atlanta, Ga. • Birmingham, Ala. • Boston, Mass. • Buffalo, N. Y. • Butte, Mont. • Chicago, Ill. • Cleveland, O. • Denver, Colo. • Detroit, Mich. Hamilton, O. • High Point, N. C. • Houston, Tex. • Jacksonville, Fla. • Kansas City, Mo. • Knoxville, Tenn. • Lewiston, Me. • Miami, Fla. • Minneapolis, Minn. New Orleans, La. • New York, N. Y. • Pasadena, Cal. • Portland, Ore. • Roanoke, Va. • San Francisco, Cal. • Seattle, Wash. • Syracuse, N. Y. • Tucson, Ariz.

your
visiting facts
and
figures department

Kewanee Boilers are advertised regularly in national publications.

your
KEWANEE
man



Singly and in battery Kewanee Type C Steel Boilers have won a reputation for high capacity and efficiency—within a minimum floor space—since introduction in 1928.

• Your computations and recommendations can only be as good as the information behind them. Knowing this, your Kewanee man is data-conscious. He keeps you armed with boiler facts and figures . . . sees that you have an up-to-date catalog . . . is fast to supply specific information you request.

He can intelligently assume this responsibility because he is a qualified boiler specialist. He knows boiler problems—and answers—from years of experience. Also, he maintains close contact with engineering experts at Kewanee Boiler Division—can keep you abreast of latest applications in the field.

His competence keeps pace with the famed performance of Kewanee Boilers themselves—dependable, efficient models from residential 70,000 Btu units to industrial boilers carrying a 651 h.p. rating. And he is quickly available from a nearby Kewanee Branch Office in the coast-to-coast network.

AMERICAN-STANDARD, KEWANEE BOILER DIVISION, 101 Franklin Street, Kewanee, Illinois.

AMERICAN-Standard

KEWANEE BOILER DIVISION

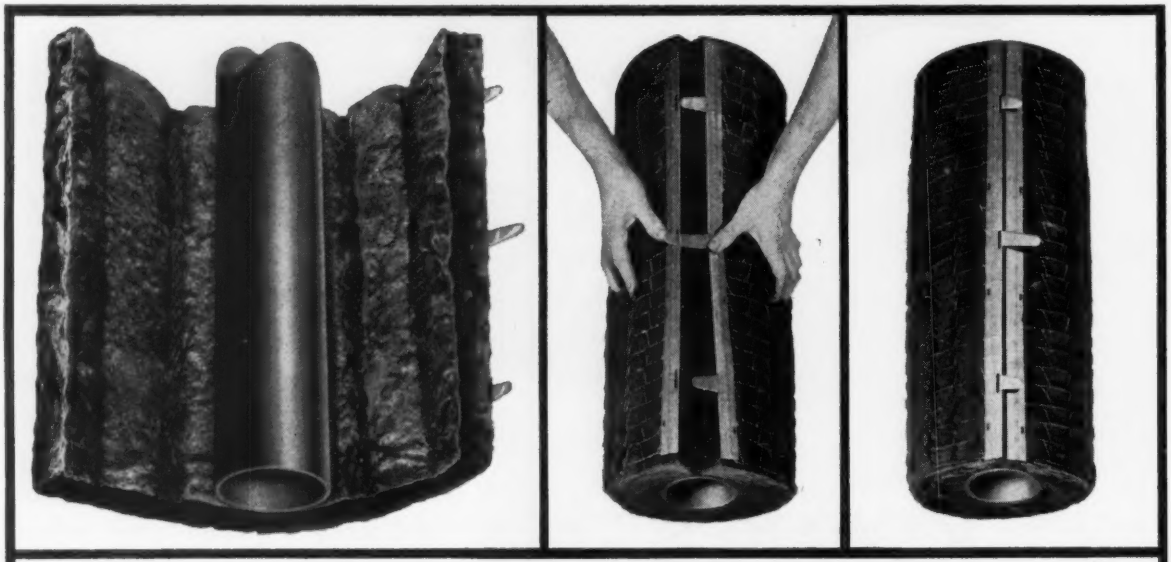
NOW! HIGH TEMPERATURE INSULATION - EASY TO APPLY

EAGLE-PICHER

TAB-LOK

PIPE INSULATION

For temperatures up to 1200F



And it's made of Eagle-Picher Mineral Wool!

SAVES TIME AND LABOR! On long overhead steam transmission and steam tracer lines, apply *Tab-Lok* in about half the time required by ordinary pipe coverings. Easy to handle . . . cut and fit . . . simply draw tabs through slots, pull taut and bend tabs over. No reinforcing needed!

PRECISION-MADE TAB-LOK is Eagle-Picher's new, highly efficient mineral wool pipe insulation, especially designed for fast, easy application on steam piping and hot lines up to 1200 F.

TIGHT, UNIFORM INSULATION! Durable metal fabric and galvanized strips keep *Tab-Lok* in uniform alignment. The unique tab-and-slot feature assures tight, close-butted joints.

WHAT'S MORE . . . Eagle-Picher's new *Tab-Lok* pipe insulation is highly resilient for minimum stress in expansion and contraction of heated equipment. It's water-repellent, corrosion-resistant, fire-resistant, vibration-resistant! Its greater efficiency plus ease and speed of application, saves you money!

Eagle-Picher produces a complete line of industrial insulations for all temperatures from below Zero to over 2000 F.

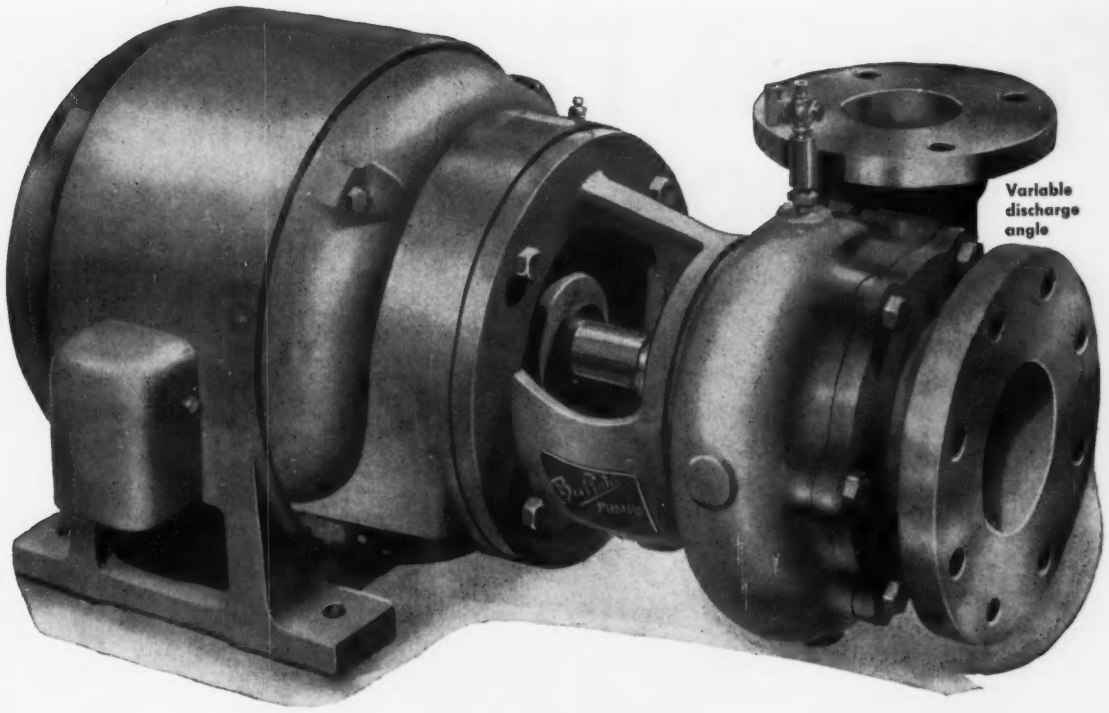
Since 1843

EAGLE EP PICHER

EAGLE-PICHER

The Eagle-Picher Company • General Offices: Cincinnati 1, Ohio

(Member of Industrial Mineral Fiber Institute)



Easily mounted, horizontal or vertical

No shaft alignment problem on installation or later

Rugged Solid Shell

Removable side plate

SMALL SIZE - BIG PERFORMANCE - FLEXIBLE INSTALLATION

These husky, compact pumps fit into cramped quarters with ease and deliver big-pump performance with a minumum of installation and service time.

"Buffalo" Close-Coupled Pumps have permanently aligned shafts plus adjustable discharge angle, affording wide flexibility in mounting and piping. And beyond these advantages, they're built for the reliability and efficiency inherent in all "Buffalo" Pumps — with deep, 8-ring stuffing boxes — oversize shafts — sturdy casings with passages offering minimum friction — overall solidity and strength — and the well-known efficient "Buffalo" impellers.

For many clear water services, including chilled water, "Buffalo" Close-Coupled Pumps are the logical choice for yourself and the customer. Write for Bulletin 975-D for a check on sizes, specifications and performance.

"BUFFALO" CLOSE-COUPLED PUMPS FOR CLEAR WATER 1" to 6" sizes 10 to 1100 gpm Up to 360-ft. head (300 gpm)

"Buffalo" PUMPS

BUFFALO PUMPS

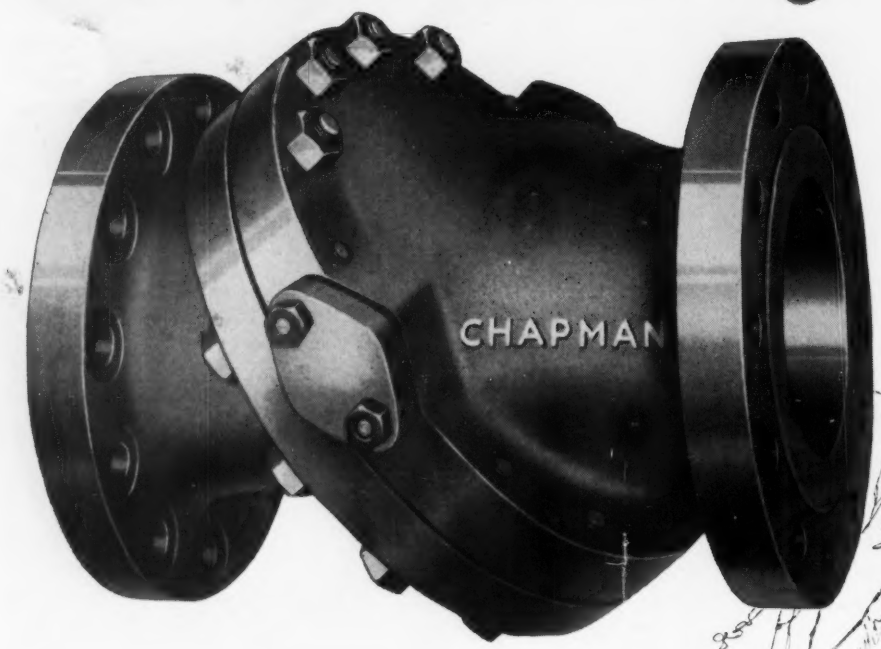
Division of Buffalo Forge Co.

488 Broadway • Buffalo, N. Y.

Canada Pumps, Ltd., Kitchener, Ont. *Sales Representatives in all Principal Cities*

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

First with Floating Power



ALWAYS QUIET... ALWAYS QUICK

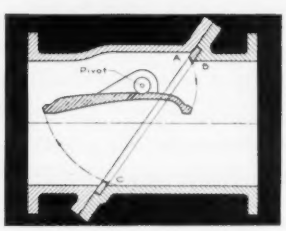
CHAPMAN

Tilting Disc Check Valve

You hear a lot about floating power these days. But Chapman Tilting Disc Check Valve has had it for quite some time. In fact Chapman was the first to have it in a valve . . . a feature that means much more to you in performance, much less to you in costs.

With Chapman's Tilting Disc Check Valve the "Airfoil" disc floats on the flow. When the flow is on, the disc balances perfectly . . . and quietly. There's never a flutter. No vibration. No trouble with head loss or flow resistance. And after the flow subsides the disc automatically drops to a closed position. The closing is fast. The closure is tight. No slamming. No banging. No damage to valve or system. No scraping or wearing of disc and seat. It all adds up to top performance and lowest maintenance and replacement costs even under severe operating conditions.

For handling fluids or gases under a wide range of pressures, always specify Chapman Tilting Disc Check Valves. They're available in iron or steel. Explained in full in our Catalog 30-A. Yours for the asking. Write.

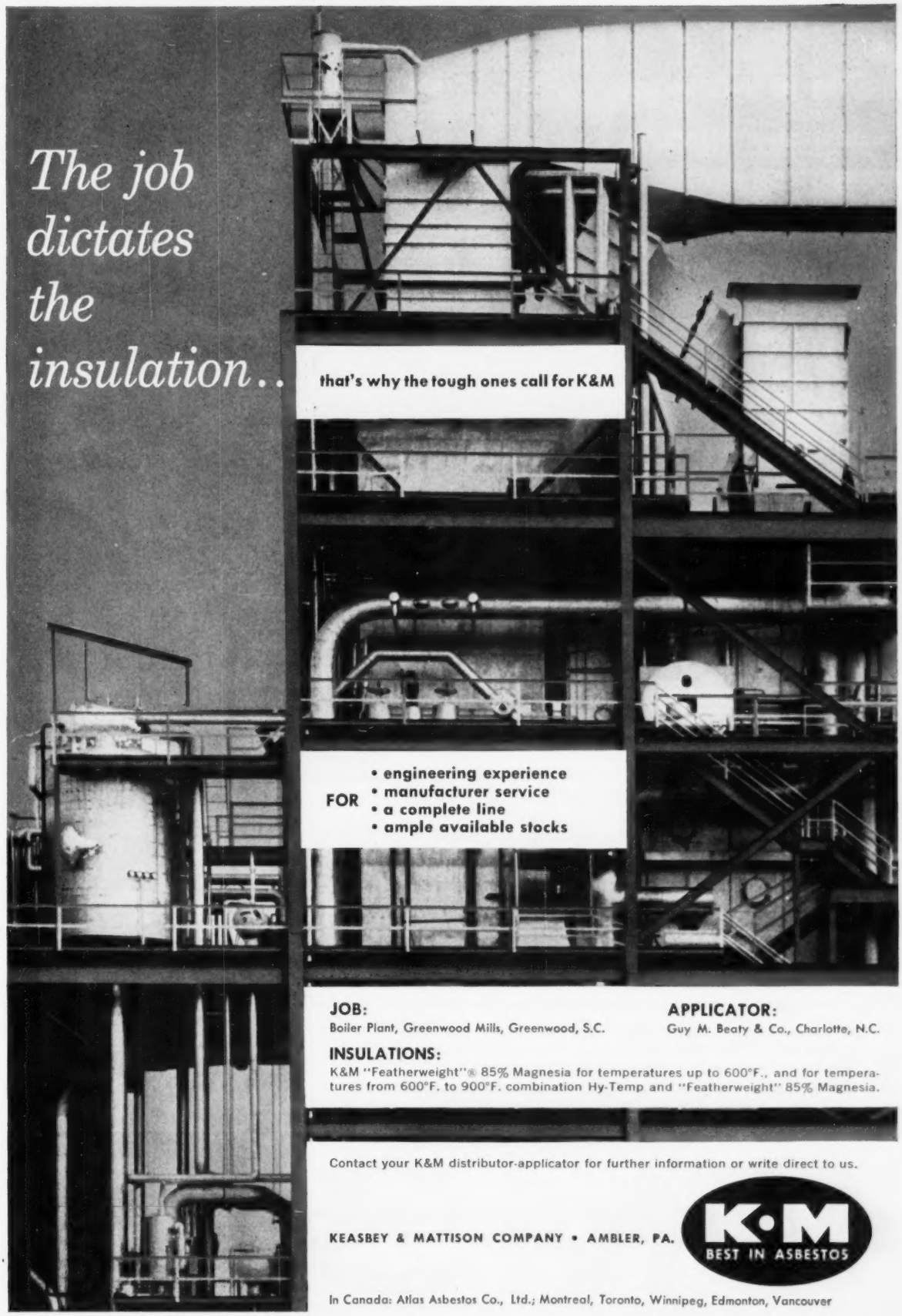


Cross-section of the Chapman Tilting Disc Check Valve illustrating the way that the balanced disc is supported on the pivot, with arrows showing the travel of the disc. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.

The CHAPMAN Valve
Manufacturing Co.
INDIAN ORCHARD, MASS.

The job dictates the insulation..

that's why the tough ones call for K&M



FOR

- **engineering experience**
- **manufacturer service**
- **a complete line**
- **ample available stocks**

JOB:
Boiler Plant, Greenwood Mills, Greenwood, S.C.

APPLICATOR:
Guy M. Beaty & Co., Charlotte, N.C.

INSULATIONS:
K&M "Featherweight"® 85% Magnesia for temperatures up to 600°F., and for temperatures from 600°F. to 900°F. combination Hy-Temp and "Featherweight" 85% Magnesia.

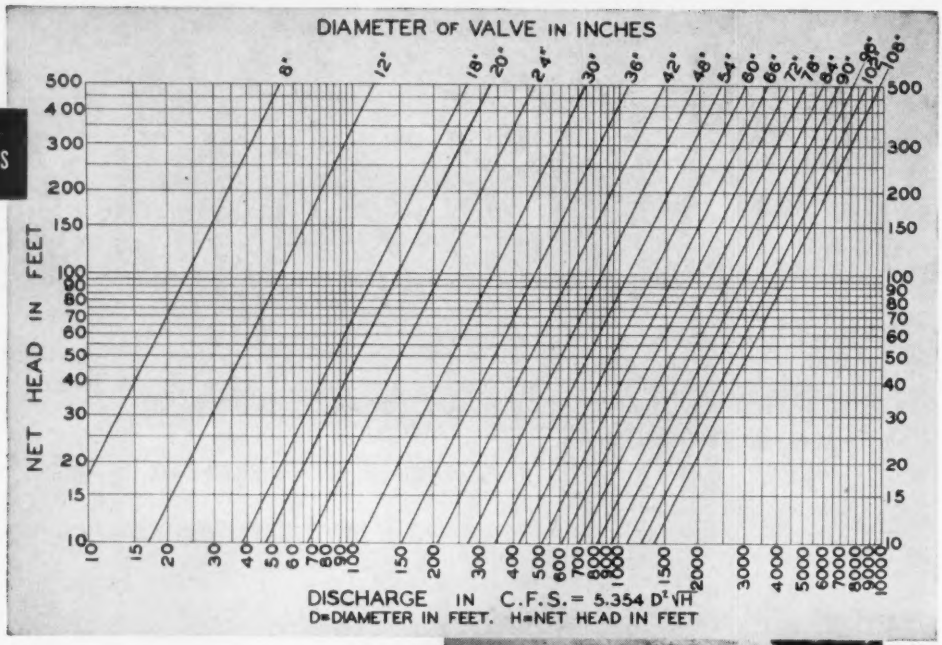
Contact your K&M distributor-applicator for further information or write direct to us.

KEASBEY & MATTISON COMPANY • AMBLER, PA.

K·M
BEST IN ASBESTOS

In Canada: Atlas Asbestos Co., Ltd.; Montreal, Toronto, Winnipeg, Edmonton, Vancouver

SMS
HOWELL-BUNGER VALVES



EASY REGULATION OF FREE DISCHARGE THROUGH HIGH TO LOW HEAD RANGE

SMS Howell-Bunger Valves provide easy regulation and control of water under free discharge. Tremendous amounts of energy can be dissipated with a minimum of erosion, cavitation and no vibration. Because of this valve's high discharge coefficient, pipe line or conduit size can be held to a minimum for economical construction.

The extremely rugged and simple design of the SMS Howell-Bunger Valve provides these essential features:

- Free discharge with safe energy dissipation
- Hydraulic balance without vibration
- High coefficient of discharge for an energy dissipating valve
- Minimum cavitation and maintenance
- Simplicity of operation
- Only one moving part in contact with stream flow
- Low initial cost
- Discharges into atmosphere or submerged.

S. Morgan Smith Company offers you more than 75 years experience with hydraulic equipment. The SMS name plate is your assurance that performance will equal or exceed specifications. For full information on Howell-Bunger Valves, turbines and related hydraulic equipment write the S. Morgan Smith Company, York, Pennsylvania.

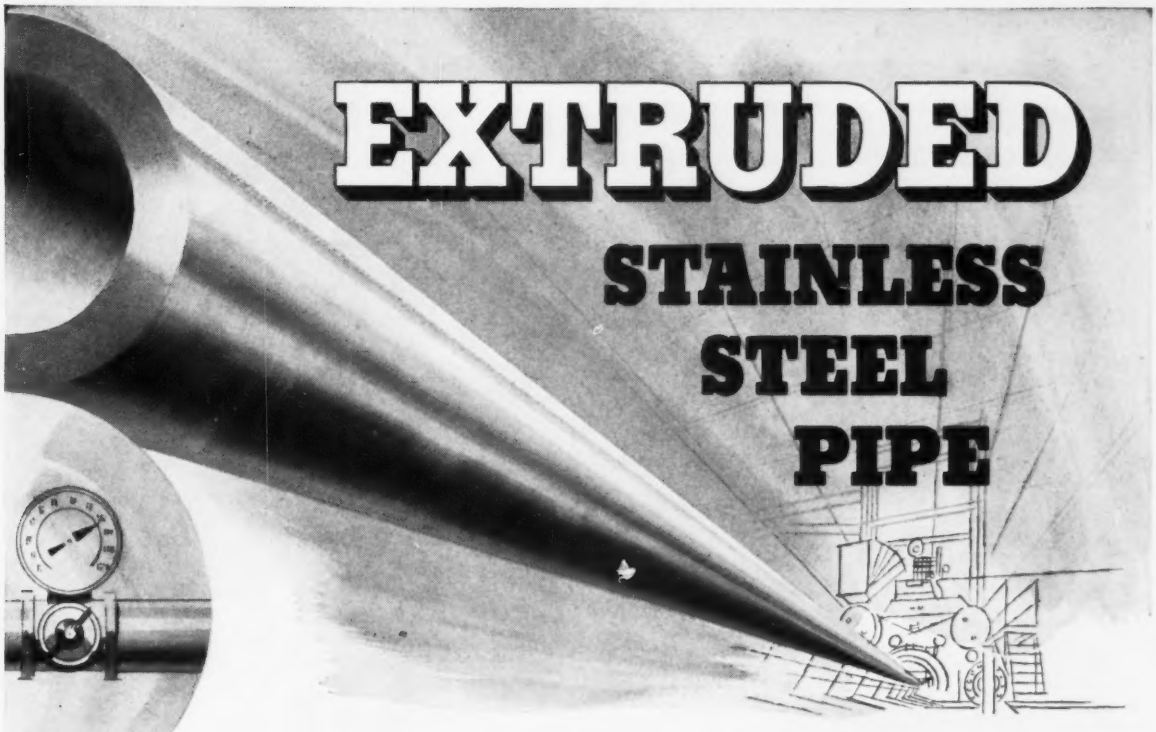
Hydraulic Turbines
Pumps
Gates & Hoists
Trash Rakes
Accessories

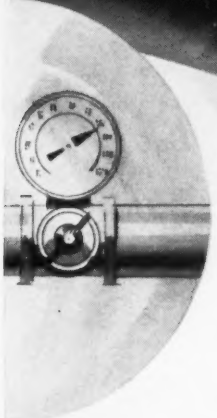
HYDRODYNAMICS

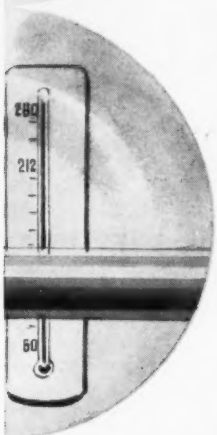
Rotovalves
Ball Valves
Butterfly Valves
Free-Discharge Valves
Controllable-Pitch Ship Propellers

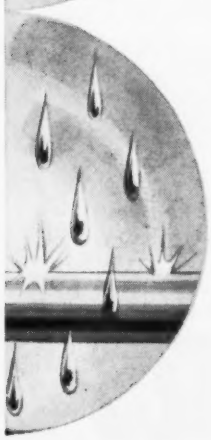
S. MORGAN SMITH CO.

AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO









...for maximum service in high pressure, heat and corrosion applications

- Type 310 and 316 alloys
- 10 to 20 inch diameters
- Lengths to 50 feet
- Schedule 40 and heavier wall thicknesses

High Integrity Pipe, for the toughest applications of the power, petroleum, chemical, and other industries, is now being *extruded* at the Metals Processing Division of Curtiss-Wright. In the Division's giant 12,000-ton horizontal steel extrusion press, the inherent properties of stainless steel alloys are transformed into pipe to your specification under tremendous one-push pressures. The result is uniformly high strength ... high resistance to pressure, heat and corrosion. Investigate the superiority of this new pipe for your application.

Tooling is in stock for prompt action on standard requirements as listed above. Inquiries are invited regarding special orders for diameters smaller than 10 inches and for alloys other than the standard 310 and 316.

88 GRIDER STREET

METALS PROCESSING DIVISION
CURTISS-WRIGHT
CORPORATION • BUFFALO, N. Y.

Branch Offices:
50 Rockefeller Plaza, New York, New York • 131 N. Ludlow Street, Dayton 2, Ohio • 2700 Lincoln Blvd., Santa Monica, Calif. • 4101 San Jacinto, Houston 4, Texas • City Bank Bldg., Chicago, Illinois
In Canada: CURTISS-WRIGHT of Canada, Montreal, Que.

FREE LAYOUT SERVICE

assures better storage facilities for less money

Find out how to store more stock in less space . . . how to make maximum use of each unit to reduce equipment investment . . . how to arrange units for fastest stock handling . . . proper width of aisles, location of packing benches, and other valuable data by using Equipto's FREE LAYOUT SERVICE. Profit by the aggregate experience of trained Equipto engineers who have designed hundreds of layouts of every description.

For simpler layouts, or for those who wish to design their own facilities, Equipto offers a fact-crammed free booklet entitled, "How to Solve Your Storage Problems."

Write today for your copy of booklet or advise when our layout engineer should call.

Equipto

Division of Aurora Equipment Co.
744 Prairie Avenue, Aurora, Illinois

Steel Shelving...Parts Bins...Drawer Units...Lockers...Carts...Work Benches

---

Write for

Power's

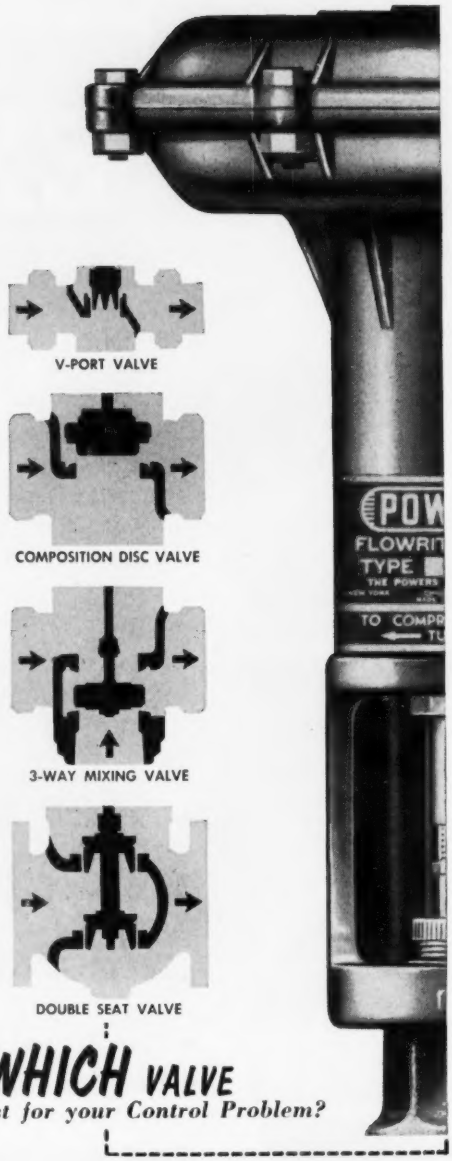
REPRINT FOLDER

...SUMMARIES and PRICES

on **Power's** information-packed

SPECIAL REPORTS

"the most useful condensed handbooks in the power and plant service field."

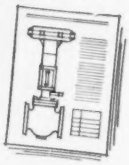


WHICH VALVE

is best for your Control Problem?

Ask your nearest Powers representative which particular valve should be specified — he knows diaphragm control valves and their applications. You'll find him ready to help you in sixty-six cities throughout the nation.

Four Powers Flowrite Valve types are available to meet every requirement for accurate and dependable control. Actuated by compressed air or water, they may be used with any pressure-operated sensing device.



WRITE TODAY for information on all four valve types . . . ask for Bulletin No. 344.

THE POWERS REGULATOR CO.
DEPT. 457, SKOKIE 24, ILL.

POWERS

How perfectly simple —this Fast's Coupling with purely mechanical flexibility!

1. A hub is keyed on each shaft. Hubs are splined at maximum distance from shaft ends.

2. Floating sleeves surround hubs. Sleeves are splined to engage hub splines.

3. Sleeves compensate for shaft misalignment by assuming neutral position between two hubs.

4. Because of distance from shaft end, any misalignment between splines is mere fraction of same misalignment between shafts.

5. Sleeves carried on bearing rings, located on *transverse center line of hub spline faces* (the load-carrying surfaces) . . . no crank action, no vibration.

6. Lubricant is centrifugally forced into spaces between engaged splines, forming a film.

For 35 years the most positive, dependable means of coupling machines to their power source . . . Fast's Couplings have no parts subject to repeated bending, tension or compression. Because there is no metal-to-metal contact, *there is no wear*—in fact, many Fast's Couplings in use for over 30 years show no signs of wear when disassembled! No leather, plastic or rubber oil seals. Lubricant film distributes pressure over a considerable area, diminishing localized stress at pressure points on the load-carrying teeth. Perfectly simple? Yes . . . and foolproof!

For coupling catalog, technical advice or assistance from Koppers field engineers, write: KOPPERS COMPANY, INC., *Fast's Coupling Dept.,* 3304 Scott Street, Baltimore 3, Maryland.

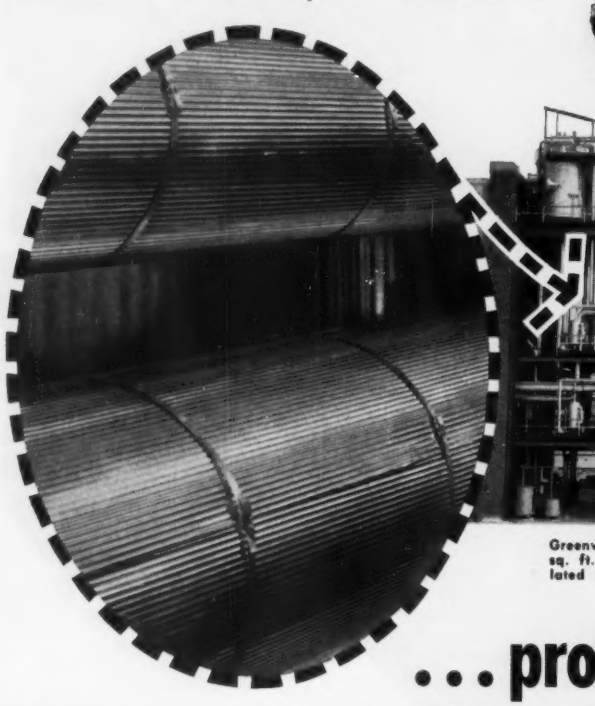
THE ORIGINAL **FAST'S Couplings**

KOPPERS

METAL PRODUCTS DIVISION • KOPPERS COMPANY, INC. • BALTIMORE 3, MD.
This Koppers Division also supplies industry with American Hammered Industrial Piston and Sealing Rings, Industrial Gas Cleaning Apparatus, Aeromaster Fans.
Engineered Products Sold with Service.

CHILDERS JACKETING...

Increases efficiency of insulation



Greenwood Mills, Greenwood, S. C., uses over 100,000 sq. ft. of .006" Childers Jacketing to protect insulated lines at its newly-completed Mathews Plant.

W. L. Bross, Chief Engineer at Greenwood Mills

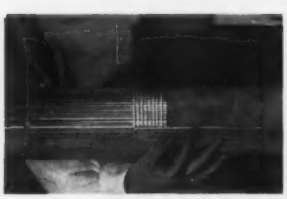
...protects insulated lines, decreases heat loss, improves appearance

Leading power plant engineers are discovering to their profit that insulation on steam lines *lasts far longer* when protected with Childers Aluminum Jacketing. This durable jacketing eliminates costly maintenance and repairs. It protects the insulation indefinitely against damage from workmen, equipment and dripping fluids like oil and grease. Outside lines covered with Childers Jacketing are safe from exposure to weather. Periodic inspection of the insulation is easy with the removal of any section of jacketing.

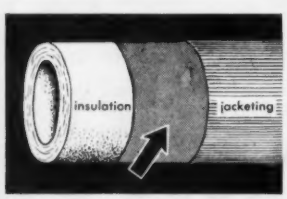
Childers Jacketing on power plant lines and equipment has the added benefit of *effectively reducing the heat lost by radiation.* Engineers have determined that Childers Jacketing improves the efficiency of insulation and therefore decreases fuel consumption. The result is fewer BTU's lost per KWH.

With Childers Jacketing, older power plants, as well as new, take on a trim, modern appearance. Unlike ordinary sheet aluminum, Childers Jacketing has a 3/16" cross corrugation rolled in it. This cross-crimping reduces glare, makes dirt less visible. Housekeeping is easier — your plant is always a credit to the community.

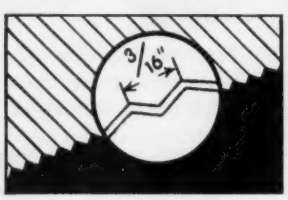
Write: Childers Manufacturing Co., Dept. P-4, 3620 West 11th St., Houston 8, Texas.



LAP SEAL, available at no extra cost, is a series of 8 ribs rolled into the underlapping edge of the jacketing, providing an automatic measure of the 2" circumferential lap. Proper lap is insured without waste. Labor is saved. Where desired, a positive weather seal is easily made with Lap Seal and a mastic.



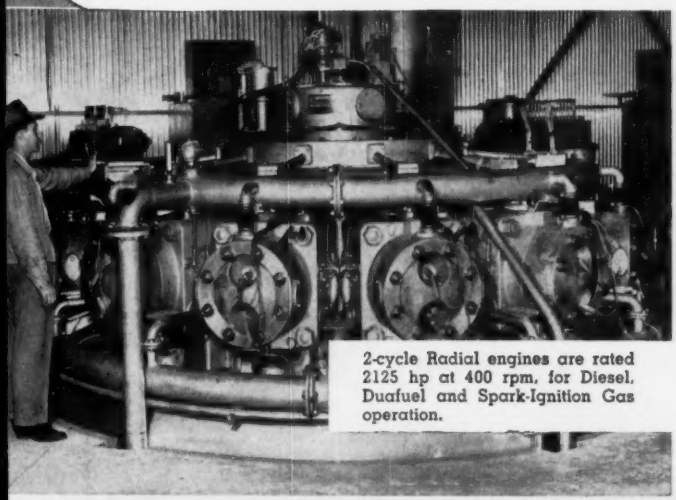
FACTORY-ATTACHED MOISTURE BARRIER protects the underside of aluminum from possible attack by alkaline solutions present in most insulating materials. The moisture barrier, bonded at the factory by continuous strip adhesive, adds little to cost, saves application labor, insures against underneath corrosion.



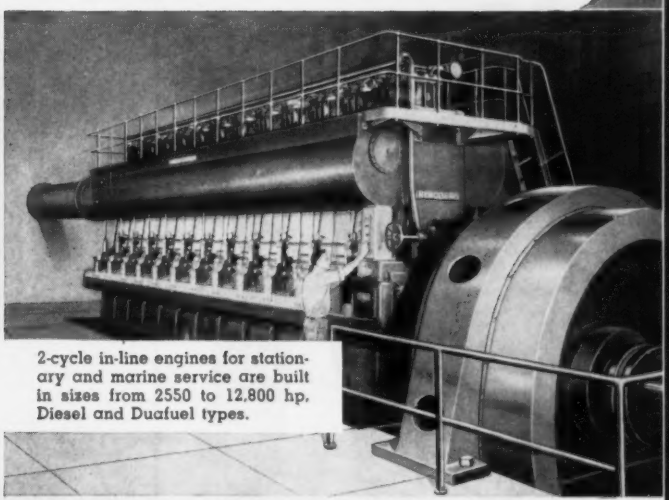
TESTS PROVE EXTRA STRENGTH of rolled-in 3/16" cross corrugation. Vertical strength and rigidity of a .016" sheet with this 3/16" cross corrugation are increased to that of a plain .024" sheet. Jacketing costs are consequently reduced by as much as 1/3 when Childers Jacketing is used instead of ordinary sheet aluminum.

CHILDERS HEAVY WEIGHT ALUMINUM JACKETING is recommended for extra protection of lines along walkways and other areas subject to physical abuse. Also recommended for protection of insulated towers, vessels and tanks. Only Childers offers .019" Heavy Weight jacketing in labor-saving 4' wide rolls.

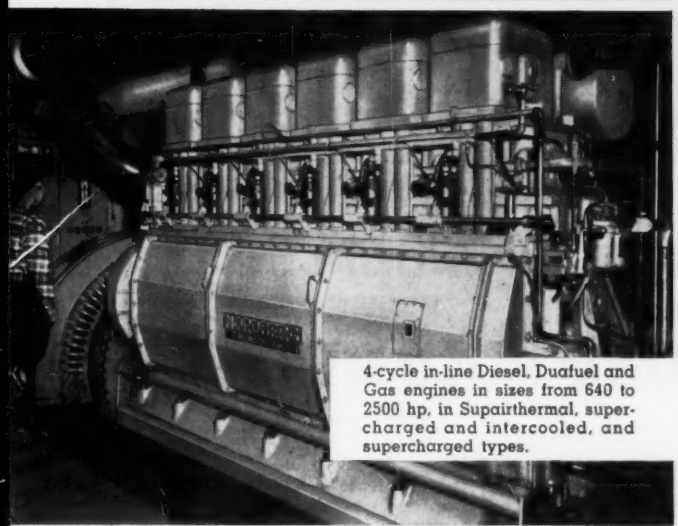
NORDBERG Engines and Experience can solve your power problems . . .



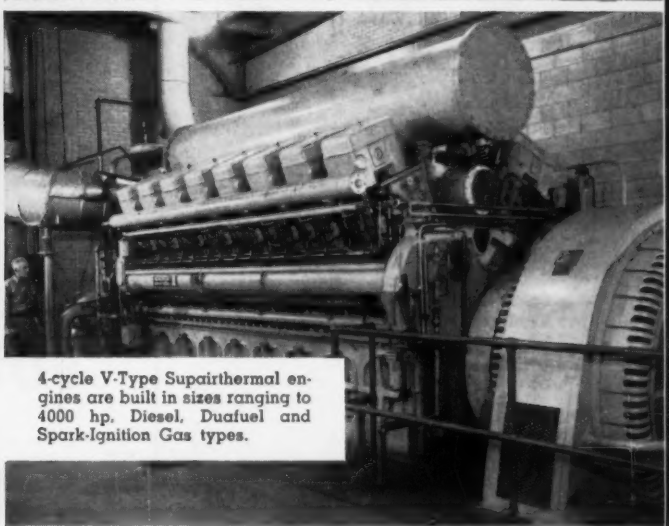
2-cycle Radial engines are rated 2125 hp at 400 rpm, for Diesel, Duafuel and Spark-Ignition Gas operation.



2-cycle in-line engines for stationary and marine service are built in sizes from 2550 to 12,800 hp, Diesel and Duafuel types.

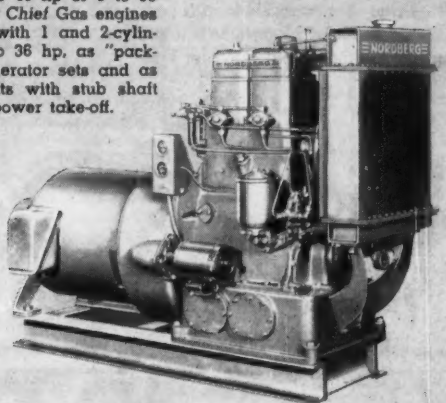


4-cycle in-line Diesel, Duafuel and Gas engines in sizes from 640 to 2500 hp, in Supairthermal, supercharged and intercooled, and supercharged types.



4-cycle V-Type Supairthermal engines are built in sizes ranging to 4000 hp, Diesel, Duafuel and Spark-Ignition Gas types.

Power Chief® Diesels are offered with 1, 2 and 3-cylinders, rated 10 to 45 hp or 6 to 30 kw. *Power Chief* Gas engines are built with 1 and 2-cylinders, up to 36 hp, as "packaged" generator sets and as power units with stub shaft of clutch power take-off.



• Pioneer in the Diesel and Gas engine industry, Nordberg has contributed many of the most notable advancements in the development of more efficient prime movers . . . all in the interest of improved fuel economy, simplicity of design, less maintenance and better overall performance. As a result of this experience, Nordberg today . . . with a full range of engine sizes, from 10 to over 12,000 hp, including Diesel, Duafuel® and Spark-Ignition Gas types, is in the best position to help solve your stationary and marine power problems.

NORDBERG MFG. CO., Milwaukee, Wis.

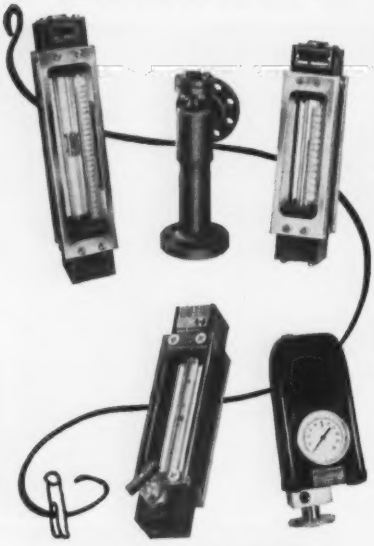
NORDBERG
DIESEL • DUAFUEL® AND SPARK IGNITION GAS ENGINES

© 1957, Nordberg Mfg. Co.

P557

BROOKS LEADERSHIP
achieved through design

ROTAMETERS



a FULL LINE
for every service

Whatever your flow measurement or remote transmission needs . . . Brooks has the answer. Moreover, it is a *practical* answer . . . because the same practical design features are carried through the line. From Hi-Accuracy Flow Indicators to low-cost purge meters . . . from the well-known Ar-Met Armoured Meter to the new convertible electric or pneumatic flow transmitters, you'll find these common features: self-alignment of essential parts, simplified cleaning and assembly, and designs that eliminate troublesome line strain on the metering elements.

You can depend on Brooks rotameter equipment for *lowest final cost* all down the line—because it has been performance-proven where it counts most: in daily service.

Send for your copy of Bulletin 110b, a brief, well illustrated guide to Brooks Rotameters and Accessory Equipment.

BROOKS ROTAMETER COMPANY
457 K Street, Lansdale, Pa.

the new standard of flow measurement and control

Power's
SPECIAL REPORTS

Now available in
BOUND VOLUME form

Now it is possible for you to have your favorite POWER Special Editorial Reports in bound volume form. If you are interested in this volume containing 40 Special Reports, drop us a note, together with $25.15 (checks or money orders are acceptable) and we will do the rest. Within three weeks after we receive your order, you will be sent this handsomely bound volume in maroon cloth with your name die stamped on it in 14 K gold. This volume is a must for your technical library . . . of permanent reference value.

Send your order today to:

George Keates, c/o POWER,

330 West 42nd St., New York 36, N. Y.

WHERE TO BUY

Featuring additional products specialties and services for power plants

TO manufacturers of equipment and those offering special services to the power industry, this section offers an inexpensive means of keeping products or services regularly before your potential customers — the readers of POWER. The small spaces available here provide opportunity for you to be represented in every issue at low cost. Can we serve you?

POWER — Classified Advertising

STEEL PIPE & TUBING

• CHROME MOLY • CARBON MOLY
• CARBON STEEL • STAINLESS

Widest Range of Sizes & Specs in the U. S.
WRITE FOR STOCK LIST

MIDCONTINENT TUBE SERVICE, INC.
2308 Oakton St., Evanston, Ill. DA 8-4030

PROFESSIONAL SERVICES

CONSULTING DESIGN EXAMINATIONS PATENTS
CONSTRUCTION PLANS SURVEY • REPORTS TRADE MARKS

BLACK & VEATCH
Consulting Engineers
Electricity—Water—Sewage—Industry
Reports, Design, Supervision of Construction,
Investigations, Valuation and Rates
1500 Meadow Lane Pkwy, Kansas City 14, Missouri

THE LUMMUS COMPANY
Engineers and Constructors
385 Madison Ave., New York, N. Y.
Chicago . . Houston . . London
Paris . . The Hague . . Montreal
Caracas . . Bombay

J. E. SIRRINE COMPANY
Engineers
Power Plant Consultations
Design Reports
Water Steam Utilization Plants
Greenville South Carolina

BURNS & McDONNELL
Engineers—Architects—Consultants
Kansas City, Mo. Phone
P. O. Box 7088 DElmar 3-4375

LUTZ AND MAY COMPANY
Consulting Engineers
Steam, Gas & Diesel Power Station
Pumping Plants—Electric Systems
Reports—Design—Appraisals
1009 Baltimore Kansas City 6, Mo.

STANLEY ENGINEERING COMPANY
Consulting Engineers
Hershey Building 208 S. LaSalle St.
Muscatine, Ia. Chicago 4, Ill.

GILBERT ASSOCIATES, INC.
Engineers and Consultants
Design and Construction Supervision
Mechanical • Electrical • Structural
Sanitary • Chemical Laboratory
Business and Economic Research
New York Reading, Pa. Washington

PIONEER SERVICE & ENGINEERING CO.
Consulting and Design Engineers
Purchasing
Specialists in
Financing, Accounting & Other Operations
231 So. La Salle St. Chicago 4

SWANSON, WRIGHT & CO. ENGINEERS LTD.
Consulting Engineers
Industrial and Process
Forest Products Industries
Power Plants
Reports, Specifications, Designs, Supervision
2210 West 12th Ave., Vancouver 9, B.C. CEdar 1154

INTERNATIONAL ENGINEERING COMPANY, INC.
Engineers
Investigations — Reports — Design
Procurement — Field Engineering
Domestic and Foreign
74 New Montgomery St., San Francisco 5, Calif.

SANDERSON & PORTER ENGINEERS
Design
Construction
New York New York

TIPPETT & GEE CONSULTING ENGINEERS
Mechanical—Electrical—Thermodynamic—Structural
Design—Studies—Supervision
Power Stations—Transmission—Distribution
Industrial Plants—Process
1333 North Second Street Abilene, Texas

THE KULJIAN CORPORATION
Engineers - Constructors - Consultants
POWER PLANT SPECIALISTS
(Steam, Hydro, Diesel)
Utility • Industrial • Chemical
1200 N. Broad St. Philadelphia 21, Pa.

SARGENT & LUNDY
Engineers
140 South Dearborn St. Chicago, Illinois

WATER SERVICE LABORATORIES, INC.
Specialists in Water Treatment for Corrosion Prevention
Main Office:
423 W. 126 St. New York 27, N. Y.

PETER F. LOFTUS CORPORATION
Design and Consulting Engineers
Electrical • Mechanical • Structural
Civil • Thermodynamic • Architectural
First National Bank Building
Pittsburgh 22, Pennsylvania

SEELYE STEVENSON VALUE & KNECHT
Consulting Engineers
Mechanical—Electrical—Civil
Surveys Reports Design
101 Park Avenue New York 17, N. Y.

THE J. G. WHITE ENGINEERING CORPORATION
Design-Construction-Reports-Appraisals
80 Broad Street, New York 4

EMPLOYMENT OPPORTUNITIES

The Advertisements in this section include all employment opportunities—executive, management, technical, selling, office, skilled, manual, etc.

Positions Vacant
Positions Wanted
Part Time Work

Civil Service Opportunities
Selling Opportunities Wanted
Selling Opportunities Offered

Employment Agencies
Employment Services
Labor Bureaus

DISPLAYED ——**RATES**—— **UNDISPLAYED**

The advertising rate is $25.00 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

An advertising inch is measured ⅞" vertically on a column—8 columns—80 inches to a page.

Subject to Agency Commission.

$1.65 per line, minimum 3 lines. To figure advance payment count 5 average words as a line.

Box Numbers—counts as 1 line

Discount of 10% if full payment is made in advance for 4 consecutive insertions.

Not subject to Agency Commission.

Send NEW ADS or Inquiries to Classified Advertising Div. of Power, P. O. Box 12, New York 36, N. Y. for May issue closing April 9th.

Electrical Engineers Designers

BECHTEL

Offers you immediate long range engineering opportunity in

San Francisco
or
Los Angeles, Calif.

Engineers, designers and draftsmen required with the following experience:

Electrical Sub-Station
Hydro-Electric Power Plants
Steam Electric Generating Station

Liberal relocation allowances for you and your family.

Send Resume to
Manager of Employment & Placement
Industrial Relations Division

BECHTEL
CORPORATION
220 Bush Street
San Francisco 4, Calif.

For an immediate personal interview you may phone:
Paul Keating, MUrray Hill 7-7100, New York City
Joe Braddick, Fairfax 3-2401, Houston, Texas
Bill Billings, Tucker 1549, Los Angeles, Calif.
Don Palmer, Douglas 2-4032, San Francisco, Calif.

POWER ENGINEER

Opportunity available for graduate engineer, preferably mechanical with five or more years experience in all phases of power and related plant utilities.

Responsibilities will cover design, installation, studies, and recommendations—including water treatment, steam generation, electric distribution, and refrigeration; for a major chemical manufacturing corporation with multi-plant installations in eastern United States.

Excellent opportunities for growth and advancement.

Please write to:
G. A. DUCCA
Placement Supervisor
MERCK & CO., INC.
Rahway, New Jersey

REPLIES (Box No.): Address to office nearest you c/o this publication Classified Adv. Div.
NEW YORK: P. O. Box 12 (36)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITIONS VACANT

Designers—Electrical and Piping . . . Power Plants and Industrial Buildings. Marbarry Corp., 120 Greenwich St., New York City 6, N. Y. REctor 2-3749.

Hospital Engineer, Glens Falls Hospital, Glens Falls, New York, 50 miles north of Albany on Hudson River foothills of Adirondack Mountains. 300 bed hospital. Require technical education and several years experience chief engineer of hospital. Fine American community and good labor market. Excellent area to raise family and wonderful outdoor recreation summer and winter. Salary open; will depend upon experience. William G. Illinger, Superintendent.

The University of Nevada at Reno, Nevada has openings on the teaching staff of the College of Engineering at the ranks of Instructor or Assistand Professor in Mechanical Engineering. Address Dean of Engineering for particulars.

Combustion Engineer wanted by largest coal operator in its field for service to utilities, industries, commercial and domestic plants, and assistance in research. Attractive pension plan, hospitalization coverage, joint stock purchase program. In reply advise schooling, experience, expected starting salary, age, marital status. P-4588, Power.

SELLING OPPORTUNITIES OFFERED

Water conditioning equipment manufacturer desires agents for New England and Upstate New York area. RW-3789, Power.

Established manufacturer with complete line of water treatment, fuel oil treatment and soot remover products desires representation in New England and Midwest areas. Excellent opportunity for men with allied lines and following in industrial power plants. High Commissions. RW-4655, Power.

POSITIONS WANTED

Division Superintendent in diesel-hydro system, now employed abroad, available July 15th. ICS diploma in electrical engineering; age 39. Prefer eastern U.S. P-4346, Power.

Mechanical Maintenance Supervisor, age 33, married, technical education, approx. 2 yrs. college, 12 yrs. experience on steam turbines, last 5 yrs. steam service engineer on large utility turbo-generators. PW-4549, Power.

Stationary Engineer 38: Desires relocation in modern power plant in midwest. 14 years operation and maintenance steam power plants. Ohio 1st class license. Experienced switchboard operator. Present salary $460 monthly. PW-4595, Power.

SELLING OPPORTUNITY WANTED

Sales engineer desires line of chemical solution proportioning pumps for metropolitan New York. SA-3510, Power.

Personnel Managers — Need experienced Engineers and Technicians? We offer a booklet especially prepared to help you solve this problem. Write for your "free" copy of "Reservoir of Engineers and Technical Men." Power, P. O. Box 12, New York 36, N. Y.

MECHANICAL ENGINEER

Large engineering and construction firm located in New York has staff position open for a Mechanical Engineer with experience in steam electric station operation to engage in plant betterment work which involves assistance in starting new units, testing, advising and consulting in respect to operating problems, improving steam plant efficiencies, advising in respect to procedures and maintenance practices, and related problems. Reasonable knowledge of water treatment problems, practices etc. desirable.

Substantial travel involved. Salary commensurate with experience. Attractive company benefits. Give full particulars, age, education, experience in detail, and salary expected.

Send complete resume to Dept. B

P-4308, POWER
Class. Adv. Div., P.O. Box 12, NY 36, NY

MECHANICAL ENGINEER

Permanent position in long established central engineering department of one of country's fastest growing companies. Graduate, 5 to 10 years' experience industrial process engineer, full responsibility for project development, estimating, drawings and specifications, equipment ordering. No drafting. For more information write

Personnel Manager
AMERICAN-MARIETTA COMPANY
101 E. Ontario, Chicago 11, Illinois

When Answering
BOX NUMBERS . . .

to expedite the handling of your correspondence and avoid confusion, please do not address a single reply to more than one individual box number. Be sure to address separate replies for each advertisement.

CLASSIFIED **SEARCHLIGHT SECTION** ADVERTISING

BUSINESS OPPORTUNITIES — EQUIPMENT - USED or RESALE

UNDISPLAYED RATE:

$1.65 a line, minimum 3 lines. To figure advance payment count 5 average words as a line.

PROPOSALS $1.65 a line an insertion.

BOX NUMBERS count as one line additional in undisplayed ads.

DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

DISPLAYED RATE:

The advertising rate is $17.90 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page.

EQUIPMENT WANTED or FOR SALE ADVERTISEMENTS acceptable only in Displayed Style.

Send NEW ADVERTISEMENTS or Inquiries to Classified Advertising Div. of Power, P. O. Box 12, N. Y. 36, N. Y. for May issue closing April 9th

OPPORTUNITIES!

in

New and used equipment recently released from service by a number of electric and gas utility companies

POWER PLANT EQUIPMENT
CONSTRUCTION EQUIPMENT
SUBSTATION EQUIPMENT
TRANSMISSION LINE MATERIALS

Send for new list . . . to

EBASCO SERVICES INCORPORATED

APPARATUS EXCHANGE

Two Rector St., New York 6, N. Y.

FOR SALE
DIESEL POWER PLANTS

2—Chicago Pneumatic, 6 cyl. Diesel Engines, Stationary Type, Circulating Water Cooled. Bore 8" Stroke 10½". Type 68CP, 180 H.P. 600 R.P.M. or 225 H.P. at 720 R.P.M.

1—Buda Diesel, 6 cyl. 1200 R.P.M. Model 8-D.C. 1290. Bore 5⅜" Stroke 6½". Circulating Water Cooled, w/125 K.V.A. A.C. Generator, 3 ph. 60 cyc. 1200 R.P.M. 240 volts, and Exciter. Mounted on steel base.

Price and further info. on request

PHILADELPHIA TRANSFORMER CO.
BOX 566
DALTON, PA.

400 h.p. (at 300) ATLAS Imperial 13 x 16 engine (2000 hours) stored in heated building complete in good order. NEW Murphy diesel M.K. 90 4 cyl. 5⅝ x 6⅛ full load RPM 1200 twin disc coupling 3 to 1. Also excellent dragger HULL 97 x 21 x 10.7 fully equipped less main engine priced right.

ROCKY BAY CO.
75 Central St., Boston 9, Mass., Liberty 2-4366

GUARANTEED REBUILT POWER EQUIPMENT

HERE'S A WIDE SELECTION FROM OUR GIANT STOCK

SLIP RING MOTORS

3 Phase, 60 cycle, 220 or 440 volts (*2200 volts or higher)

HP	Make	Type	Speed
2500	*G.E.	MT	257
1200	*Al-Ch.	ANT	1800
600	*G.E.	MT	450
500	G.E.	M-6345	1200
300	G.E.	IM-178	600
250	*G.E.	IM	720
200	G.E.	IM	600
200	Westg. (2)	CW	514
200	*Westg.	CW-905-A	514
150	Cr.-Wh.	50-R	1800
150	Westg.	CW	450
125	G.E. (2)	IM-15A	600
100	G.E.	IM-13A	1800
100	G.E.	MTC-5546	900
100	G.E.	IM	720
100	G.E.	IM	600
100	G.E.	IM-15A	450
75	G.E.	MT-347	1200
75	G.E.	IM	1200
75	Al-Ch.	ARY-223C	1200
75	G.E.	MT-356	900
75	Al-Ch.	ANY-26F	900
75	Al-Ch.	ARY	720
75	G.E.	MT-352	720
75	G.E.	MT-556	720
75	G.E.	IM	600
60	Al-Ch.	ARY	1200
60	G.E.	MT-546	1200
60	*G.E.	MT-536	1200
60	*Westg.	CW-762C	900
50	Westg.	CW	1800
50	G.E.	IM-11A	1800
50	*Al-Ch.	ARY	1200
50	Westg.	CW-636A	1200
50	*G.E.	MT-536	1200
50	Westg.	CW-658-A	900
50	G.E.	MT-336	900
50	G.E.	MT-346	720
50	Al-Ch.	ANY-26F	600
50	G.E.	IM	450
40	G.E.	MT-532	1200
40	*G.E.	MT-336	900

SLIP RING MOTORS

Crane & Hoist Service

3 Phase, 60 Cycle, 220 or 440 Volt

HP	Make	Type	Speed
80	G.E.	MTC-5552	600
75	Westg.	CI-756-A	600
50	Westg.	MW-334	600
50	G.E.	HIGTENV	600
35	G.E.	MTC-5536	600
20	Westg.	CI	1200
11	Westg.	CI-E464	900
10	P & H	BW-6	1800
5	P & H	BW-6	1200
5	N. West.	WRC	1200
3	G.E.	MTC-5544	900

SYNCHRONOUS MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2300 volts or higher)

HP	Make	Type	P.F.	Speed
1400	Westg.	HG	.7	900
400	Westg.	HG	1.0	900
300	G.E.	ATI	.8	720
300	*Ideal	SMM	.8	257
275	*G.E. (2)	ATI	1.0	450
250	Al.-Ch.	SYN	1.0	1200
225	G.E.	TS-6244	1.0	300
225	Elec. Mchy.		1.0	360
190	Elec. Mchy.		1.0	720
150	Al-Ch. (2)	SYN	.8	1200
150	Fair.-Mor	TJC-285	.8	720
150	*Elec. Mchy.		.8	1200
150	Westg.	HR	1.0	300
125	*G.E.	TS-7641	1.0	514
125	*G.E.	TS-6214	1.0	277
125	*Elec. Mchy.			900
115	Elec. Mchy.		1.0	240

SQUIRREL CAGE MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2300 volts or higher)

HP	Make	Type	Speed
1250	*Al-Ch. (3)	ANX	3600
1200	*Al-Ch.	ARW	1200
750	*Westg.	CS	900
500	*Al-Ch.	ARW	3500
500	Gen. Elec.	K-6345	1200
500	G.E.	KT-424	450
350	*G.E.	KT-559A	1800
250	West CS-8120S	TEFC	1800
250	G.E. (2)	KT-559	1800
250	*L-Allis	DEX-143	720
250	*G.E.	IK	600
250	G.E.	IK-17A	600
250	Westg.	CS-14	514
200	*G.E.	FT-549Y	3600
200	*G.E.	IK-13B	1800
200	G.E.	IK-16	1200
200	*Al-Ch.	ANZ-TEFC	900
200	*Westg.	CS-930A	900
200	G.E. (2)	KF-564S	720
200	*Al-Ch.	AN	720
200	Westg.	CS-1010	600
200	Al-Ch.	ARWWT	600
150	Cr. Wh.	SC-140 Vent	3450
150	G.E.	IE-13B	1200
150	*Al.Ch.	AN-30F	1200
150	G.E.	IK-15A	900
150	*Westg.	CS	600
125	*Westg.	CS-771 Sppf.	1800
125	*Al-Ch.	AR	1800
125	Westg. (2)	CS-761S	1750
125	Cr-Wh. (2)	Size 5QR	1200
125	G.E.	K-558	900
125	Al-Ch.	AN	514
100	Westg. CS	5075 TEFC	3600
100	*Westg.	CS-760A	1800
100	*G.E.	FT-542Z	1800
100	G.E.	FTRP-543	1800
100	Al-Ch.	ARZ-826FS	1200
100	*Westg.	CS-780D	1200
100	G.E.	KT-555	1200
100	Al-Ch.	AW-23DS6	1200
100	*G.E.	KF-556	900
75	G.E. (2)	FT-529Y	3600
75	Al-Ch. (3)	AR-445S	3600
75	G.E.	KG-545	1800
75	G.E.	KT-537	1800
75	*Al-Ch.	AR505S	1765
75	G.E.	KT-546S	1200
75	*G.E.	KF-542	1200
75	Westg.	CS-564C	1200
75	Al-Ch.	APZ-505	1200
75	G.E.	KT-342	1200

MOTORS
DIRECT CURRENT

H.P.	Make	Type	Speed
250	Westg.	SK-220	450/600
200	Rel. (2)	1400T	850/1200
200	Westg.	SK-201	650
200	Cr.-Wh.	CM	500
175	G.E.	ETC	750
100	G.E.	MPC	400/600
100	G.E.	RC-34	2500
100	G.E.	RC-19	575
100/150	G.E.	MCF	380/1000
50	Cr.-Wh.	CMC	700/1100
35	West (2)	SK-150	350/1000
30	Cr.W.	CCM-504	450
30/40	G.E. (2)	CD-123	400/1600
30/40	G.E.	CD-115	500/1500
25/30	G.E. (2)	RF-12	500/1500
25	G.E.	RC-32	800
25	Westg.	SK-133	575
20/25	Westg.	SK-151L	250/1000
20	Star	SB-10	1750
15	Westg.	SK-103	400/1600
10/15	Reliance	185T	400/1600
10/15	Westg.	SK-121	250/1000

MOTOR-GENERATOR SETS

KW	Make	A.C.	D.C.
1250	Westg.	6600/4160	600
1000	G.E.	12000	600
500	G.E.	4160/2300	250
400	A.C.	2300	120/240
300	G.E.	440	250
250	G.E.	440	250
200	G.E.	2300	250/275
200	Westg.	2300/4600	250/275
200	Ridgeway	2300	250
170	G.E.	440	125
150	G.E.	2300	125/250
150	A.C.	2300	275
150	Westg.	2300	125/250
150	G.E.	440	275
125	Cr-Wh. (3)	4160	125
100	G.E.	2300	250
100	Al-Ch.	2300	250
100	Elec.-Mach.	440	125
100	G.E.	440	125
90	G.E.	220/440	125
75	G.E.	440	125
50	Reliance	440	250
50	Ideal	2300	250
50	Westg.	220/440	250
50	Westg.	240	125
50	G.E.	440	125
40	G.E.	440	125
25	Westg.	220	275
20	G.E.	440	250
20	Bogue-G.E.	440	125
20	G.E.	220/440	250
15	Westg.	220/440	250
15	Ideal	440	125

DYNAMOMETERS

HP	Make	Type	Speed
125	G.E. Cr.	TLC-20	2700/6000
150	G.E. 3 Cr.	TLC-50	2500/5000
200	Westg.-Bk.	SK-151	1350/4000

PLATERS

AMP	MAKE	VOLTS
7500/3750	Elec. Prod.	6/12-220/440
7500/3750	Chandy.	12/24-220/440
6000/3000	Chandy.	12/24-220/440
2000/1000	Chandy.	6/12-220/440
1500/750	Chandy.	12/24-220/440
1500/750	Chandy.	6/12-220/440
1000/500	Chandy.	12/24-220/440

TRANSFORMERS

KVA	MAKE	TYPE	VOLT
1000	G.E. (3)	Oil	13200-2300
1000	Wagner (3)	Oil	13800-240/480
833	G.E. (3)	Oil	13800-480
667	Al. Ch. (3)	Oil	34500-2400/4160Y
677	G.E. new (1)	Oil	33000-480
500	G.E. (3)	Oil	13800-480/230
333	Al-Ch. (3)	Oil	13200-2400
250	Westg. (3)	Oil	2400/4160-480/240
150	Chg. El. (3)	Air	2300-110/220
100	Al. Ch. (3)	Oil	2400-240/480
100	Jeff. (3)	Air	2400-220/110
100	Moloney (2)	Oil	2300-220/110
100	G.E. (2)	Oil	2300-115
100	G.E. (1)	Oil	2400-120/240
100	Pitts. (3)	Oil	2400-575
100	Pitts. (1)	Oil	2400-120/240
75	G.E. (3)	Oil	2400-120/208
50	West. (3)	Oil	7200/12470-120/240
50	West. (2)	Oil	2300/1150-115

First Source for 47 Years for Quality Electrical Equipment

CHICAGO *Electric Co.*

1320 W. CERMAK RD. **CAnal 6-2900** **CHICAGO 8, ILL.**

BELYEA RE-NU-BILT

LARGE ELEC. POWER EQUIPMENT
SELECTED STOCK ITEMS
RE-NU-BILT—GUARANTEED—RE-NU-BILT
COMBINATION MILL DRIVES —
D.C. MOTORS WITH M.G. SETS & CONTROLS
PACKAGE DRIVES IN STOCK

1—1000 HP, G.E. Mill Motor, MCF, 600 volt DC, 350/700 RPM, and 1000 KW, G.E. M-G Set, 600 volt DC with 1400 HP, .8 PF, Synch. Motor 13200/6600 volt, 3 ph. 60 cy.
1—850 HP, G.E., Type MCF, 260 volt DC, 800/1200 RPM, and 675 KW, M-G Set, DC Gen., G.E., Type MCF, 260 volt, DC, with 1100 HP, .7 PF, G.E. Synch. Motor, Type ATI, 2300/4600 volt, 900 RPM, 3 phase, 60 cycle.
Above with variable voltage control.
1—800 HP, Westinghouse Mill Motor, 300 volt DC, 250/550 RPM.
1—800 HP United Gear Reducer ration 7.04:1 with 600 KW Ideal M-G Set, 300 volt DC, with 900 HP .8 PF, Synch. Motor, 2300 volt, 900 RPM, 3 ph. 60 cy.
With magnetic DC Control.

A. C. MOTORS—3 Ph. 60 Cy.

SLIP RING

Qu.	H.P.	Make	Type	Volts	Speed
2	1750	G.E.	M-579BS	4800/2400	1800
1	1500	G.E.	MT	6900	1187
1	1100	F.M.BB	SF8006S	4800/2400	1800
1	800	G.E.	MT	2300	293
1	750	G.E.	MT-573	2200	1190
1	700	Al. Ch.	D.P.	2300	500
1	500	Whse.	CW	550	350
1	400	Whse.	CW	440	514
1	350	Cr. Wh.	SIZE-718R	208/406	1765
1	350	G.E.	IM-17A	440/2200	720
1	250	Cr. Wh.	MT-424Y	4000	257
1	250	G.E.	SIZE-290	2300	350
1	250	A.C.		550	600
1	200	G.E.	IM	2200	580
1	200	G.E.	MT-557Y	2200	1760
1	150	Whse.	CW30E17	2300	435
2	125	A.C.	ANY	440	865

SQUIRREL CAGE

1	800	G.E.	KT-573	2200	1180
1	650	G.E.	FT-559BY	440	3570
2	450	Whse.	CS-1420	2300/4150	354
1	400	G.E.	1K	2200	500
1	300	G.E.	KT-553A	2300	1775
1	200	G.E.	1K-17	440	580
2	200	G.E.	KT-557	440	1800
1	150	Whse.	CS	440	580

SYNCHRONOUS

1	7000	G.E.	ATI	2240/6600	600
1	4350	C.W.	3501-8L	13800/6900	514
2	1750	G.E.	ATI	2300	3600
1	1750	G.E.	T8	2300	900
2	2000	Whse.		2300	120
1	1100	G.E.	ATI	2300/4600	900
2	350	G.E.	T8	2200	150

M-G SETS—3 PH. 60 CY.

Qu.	K.W.	Make	RPM	DC Volts	AC Volts
2	2000/2400	G.E.	450	250/300	2300/4600
1	2000	G.E.	500-25cg	660	11000
2	2000	G.E.	514	250/300	4600/2300
1	1750/2100	G.E.	514	250/300	4800/2400
1	1500	G.E.	720	600	6600/13200
1	1500	G.E.	514	250	2300/4600
1	1000	G.E.	900	260	6600
3	1000	G.E.	720	600	6600/13200
1	750	G.E.	720	275	6600/13200
1	750	G.E.	720	125/250	2300/4600
1	500	Whse.	900	125/250	440
3	300	G.E.	1200	250	2300
1	150	Whse.	1200	275	2300

WELDING M.G. SET

Gen. Elec.—1100 Kva 0.7 p.f.—2300/4600 V. 3/60 Generator with 1750 Kva—.8 p.f.—2300 V 3/60 motor complete with exciter set and controls.

TRANSFORMERS

Qu.	KVA	Make	Type	PH.	Voltages
1	3000	G.E.	OISC	3	33000x2300
1	1500	G.E.	PYRANOL	3 auto	4000/4200/4400
3	1000	G.E.	OISC	1	13800x460
2	750	G.E.	FUR	1	4800x85/55
1	833	G.E.	OISC	1	13800x460
3	500	KUHL.	OISC	1	13800x6900
3	333	G.E.	OISC	1	13200x2300
3	250	L.M.	OISC	1	14400/13800x240/120

FREQUENCY CHANGER SETS

Qu.	KW	Make	Freq.	Voltage
1	5000	G.E	60/50/60	6600/11000/6600
2	2500	G.E.	25/62.5	2300/2300
1	1000	G.E.	25/58.3	4400/2300
1	500	Al. Ch.	25/60	11000/2300
1	200	G.E.	60/3000	440/800

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	4000	G.E.	Condensing 425 — 750 F.T.T. Surface Condenser 3/60/2300/4000 V Direct con exciter.
1	1500	Whse.	Auto extraction 190 lbs. — 660° F.T.T. 60 lb. extraction 3/60/240 V. Div Conn. Exc. Auto.-Ext. Cond. 175200# U.S.P. 5/20# G. Ext. Surface Condenser—3/60/2300.
1	1000	Moore	Non-condensing 175/200 lbs. I.S.P. 5/20 lbs. G.B.P., 430/3/60.

BELYEA COMPANY, INC.

43 Howell St., Jersey City 6, N. J.

Rebuilt HEMPHILL Guaranteed EQUIPMENT

TRANSFORMERS—60 CYCLE

Qu	KVA	Make	Type	Phase	Voltages
2	750	G.E.	H	1	4600-120/240
1	750	G.E.	HT	3	4150Y-220/440
2	250	G.E.	H Pyranol	1	2400-4800/8320Y-120/240
2	250	West.		1	2300/4600-230/460
3	200	G.E.	H-KD	1	13800/12420/4600-240/480
3	200	G.E.	H	1	7800/15600-220/440
1	150	Elsler	OA	1	4160-240/480
9	50	G.E.	H	1	13750-120/240
3	50	Niagara	Air Cld	1	2300-120/240
2	37½	West.	Hyperail	1	2400/4160-240/480
4	25	West.	Hyperail	1	2400/4160-120/240
3	15	GE	H Pyranol	1	6900/11950Y-120/240
6	15	Maloney	KL	1	2400/4160Y-120/240
1	1500	Faloney	ASPL Askrel		3 2400/4160-480 Power Center.

SYNCHRONOUS MOTORS

Qu	HP	Make	Speed	Type	Volts
1	100	G.E.	900	TS	2300
1	125	G.E.	600	TS	2300
1	125	E.M.	900		4800
1	150	G.E.	1800	TS	220/440
2	150	Allis-Ch.	360		2200
1	150	West.	900		220
1	300	E.M.	720	TEFC	2300
1	500	West.	450	HR	440
1	1000	West.	360	Mill	2300/4150

SLIP RING MOTORS

Qu	HP	Make	Speed	Type	Volts
1	15	G.E.	900	MT-542	440
1	25	G.E.	900	MT-526	440
1	60	G.E.	1800	MT	220
1	60	Ideal	900	AV	220
1	75	G.E.	600	IM	440
3	150	Allis-Ch.	1800	AT RW	2300
1	200	West.	514	CW	440
1	250	West.	600	CW	440
1	350	West.	1800	CW	2300
1	500	G.E.	1200	M	2400/4150

SQUIRREL CAGE

Qu	HP	Make	Speed	Type	Volts
1	40	Wagner	1750	CP TEFC	220/440
1	25	G.E.	1170	405TEFC	220/440
1	75	G.E.	1800	K-445S	440
1	100	West.	1160	CS	440
1	150	G.E.	720	KT-562	440
2	250	G.E.	1790	K.-T.E.F.C.	2300
1	275	G.E.	1260	KT559BS	2200
2	300	G.E.	1800	K-4150V	new
1	400	Cont.	1200	N8068	2300

MOTOR GENERATOR SETS

Qu	K.W.	Make	Speed	Volts DC	AC
1	30	G.E.	1800	125	220/440 V.
3	60	E.M.	1200	125	220 v. Syn
1	150	Cr. Wh.	600	125	220/440
1	175	West.	1200	125	4150 Syn.
1	300	G.E.	1200	250	2300/4160Y S.R.
1	1000	West.	720	600	2300/4160Y

D.C. 230 VOLT MOTORS

Qu	HP	Make	Speed	Type
1	75	C.W.	900	WP
1	125	G.E.	1700	RC
2	150	C.W.	900	WP
1	250	Allis Ch.	1750	FBL149BB

A.C. HOIST MOTORS

Qu	HP	Make	Type	Speed	Volts
1	35	G.E.	MTC	565	440
2	300	G.E.	ITC-5017	600	440

"FOR POWER"
J.L. HEMPHILL & CO.
1603 54th STREET, NORTH BERGEN, N. J.
PHONE NEW YORK—LONGACRE 5-3727
PHONE NEW JERSEY—UNION 3-2600

POWER PLANT EQUIPMENT

SPECIAL OFFERINGS

TURBO-GENERATORS

1—1000 KW—240 volts—130/250# Condensing Auto. Extraction—15#—New 1945
1—1000 KW—480 volts—225# Condensing Auto. Extraction—20#
1— 400 KW—550 volts—400# Condensing Auto. Extraction—20/50# New 1948
1— 300 KWV—480 volts—210# Condensing Auto. Extraction—40#
1— 250 KW—240 volts—130#—Non-Cond. 10/12# Back pressure

TRANSFORMERS

1—500 KVA 4160/480 V. Pyranol, 3 ph.
3—500 KVA 2300/550 Volts (New 1943)
1—450 KVA—13,800/208 Volts—3 ph.—(network)

AIRFOIL F-D FANS, UNUSED.

2—50,000 CFM of air at 80° F against static pressure of 9.5" w.g.

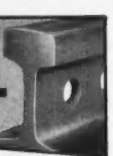
A. LEE ELLIS Co., U. S. Machy. Bldg., 140 Federal St., Boston 10, Mass:

THE BUYERS MUST BE SATISFIED—ALWAYS

IMMEDIATE DELIVERY

3—TRANSFORMERS—500 KVA, 1/60/2300-4000Y to 230/460, Whse., OISC, Modern Steel Cases. Cash for your surplus electrical equipment.

BENSON-WILIMZIG, INC.
1704 North 8th St. St. Louis 6, Mo.
Phone GArfield 1-4290



Save on Your INDUSTRIAL TRACK

FOSTER *QUALITY* **RELAYING RAILS**

FULLY GUARANTEED

Handle more cars better—cost less to install and maintain. Foster stocks all Rail Sections 12# thru 175#, Switch Material and Track Accessories.

SEND FOR CATALOGS

RAILS - TRACK EQUIPMENT - PIPE - PILING
L.B. FOSTER Co.
PITTSBURGH 30 • NEW YORK 7 • CHICAGO 4
ATLANTA 8 • HOUSTON 2 • LOS ANGELES 5

LATE PACKAGE BOILERS

Less than five years old. Pressures 160 to 250 p.s.i. 10,000 to 25,000 lbs. per hr. rating. Currently in use. Released in 60 days.

Also Steam Turbine Generators, Diesels—Transformers—Switchgear, etc.

HOWE BROS.
342 Madison Ave., New York 17, N.Y.
Telephone: MUrray Hill 2-8562

TURBO-GENERATORS

2500 KW G.E. Non-C. 3/60/2400/4160 V 3600 RPM 185 PSIG 30# BP.

1500 KW Elliott, Non-C. 3/60/480 V. 3600 RPM 240 PSIG 600° 50# BP

300 KW G.E. Non-C., 3/60/480 V 3600 RPM 150 PSIG 5# B.P.

Full line power equipment

BREW, WOLTMAN & CO., INC.
50 Church St., New York 7, N. Y.

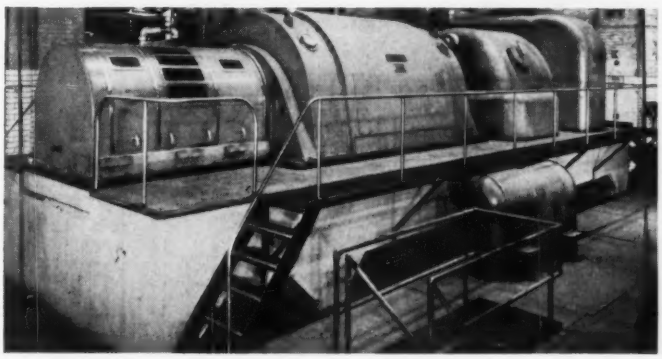
BULLETIN 9850

SPECIAL OFFERING

Just Released from Service, Immediately Available

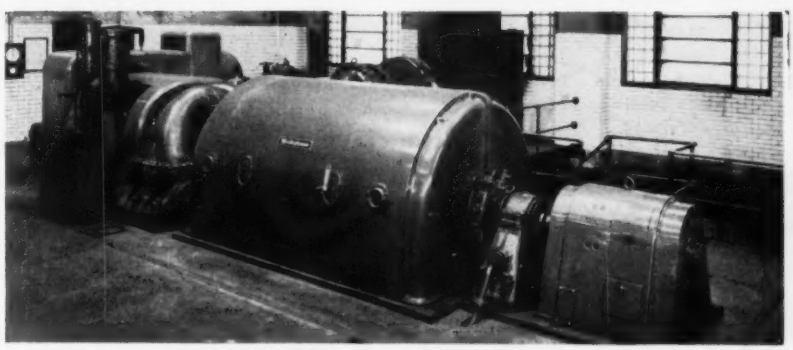
2—650 LB. PRESSURE, 750° FTT TURBINE-GENERATORS

10,000 KW, 70% P.F., 14,286 KVA below:



This 10,000 KW is a Westinghouse, Condensing 650 Lb. PSIG, 750° FTT Turbine. It is equipped with Surface Condenser, Switchboard, with all auxiliaries, direct connected Exciter (closed type). Generator is 3/60/13,200 V., 3600 RPM at 70% P.F., 14,286 KVA. Installed new in 1947.

The 5000 KW, 650 Lb. PSIG, described below, was operated same plant as 10,000 KW:



The above 5000 KW Condensing Westinghouse unit, 650 Lb., 750° FTT is in the same plant as the above 10,000 KW Turbine and is an Automatic Extraction unit 30♯, 35,000♯/hr. Generator is 3/60/13,200 V., 3600 RPM, 70% P.F., develops 7142 KVA. It is also equipped with Surface Condenser, Switchboard, closed type directly connected Exciter, and is complete with all operating auxiliaries.

Both machines can be inspected on original foundations, in operation. Investigate while available.

CHARLES WEAVER

19701 James Couzens Hwy. **Detroit 35, Michigan**

Phone: Broadway 3-1901

37 Years Dependable Service

SLIP RING MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Speed
800	2300	Whse.	900
500	4000/2300	G.E.	600
450	440	Whse.	514
400(2)	2300	G.E.	900
300	4000/2300	G.E.	720
300	2300	G.E.	900
300	440	G.E. (hoist)	600
300	440	Whse.	3600
250	2300/440	G.E.	1200
225	4000/2300	G.E. (hoist)	600
200	2300	G.E.	600
200	2200/440	G.E.	720
150	440/220	Whse.	720
150	2200/440	G.E.	600
125	2200	G.E.	600
100	440/220	G.E.	720

SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Type	R.P.M.
400	2200/440	G.E.	ATI	720
375	2200	Whse.	G	900
350	440/220	El. Machy.	Syn.	1200
300	2300/400	G.E.	TS	720
300	2200/440	G.E.	TS	1200
250	440/220	G.E.	ATI	600
150	440/220	G.E.	TS	720
125	440/220	Whse.	HR	400

SQUIRREL CAGE MOTORS

H.P.	Volts	Make	Type	Speed
600	2200	G.E.	FT	3600
500	2200/4000	Elliott	SC	1800
350	2200	G.E.	IM	900
350	440	G.E	KT	1200
300(2)	2200	G.E.	FT	3600
300	2300/4000	L. Allis	FS	1800
250	440/220	G.E.	KT	720
250	2300	Whse.	CS	600
200	440/220	G.E.	KT	1800
200	2200	G.E.	KT	1800
150	2200	Al. Chal.	AR	1800
150	440/220	G.E.	KT	720
150	2200/440		KT	600
150	2200/440	G.E.	FT	1200
125(2)	2200/440	Whse.	X-proof	720
125	2200/440	G.E.	K	600
100(2)	4000/2300	L. Allis	OX	1200

A. C. GENERATORS

1—320 kva, 660 rpm 2300/440/220 V., G.E.
1—360 kva, 900 rpm, 2300 V., Whse.
1—225 kva, 60 rpm, 220/440 V., G.E.
1—187 kva., 1200 rpm, 2200/440 V., Whse.

CIRCUIT BREAKERS

2—2000 amp. GG E., 3 pole, 600 V.
2—1600 amp. ITE, 3 pole, 600 V.
6—FKR-155-28, 600 amp., 15,000 V. G.E.
1—400 Amp., Condit, 3P, 25 KV outdoor
1—400 Amp., R. Smith, 3P 7.5 KV outdoor

D. C. MOTORS

H.P.	Volts	Make	Type	Speed
225	230	Whse.	SK	1800
200	230	Cr. Wh.	CMC	1200
150	230	El. Dyn.	B/brg.	600
125	230	G.E.	CD	850

MOTOR GENERATOR SETS

KW	Make	Input V., AC	Motor Type	Output V., DC
250	Whse.	2200	Syn.	250
150	Whse.	440/220	Sq. Ca.	275
125	G.E.	4000/440	Syn.	125
100	G.E.	2200/440	Syn.	250
75	Cr. Wh.	440/220	Sq. Ca.	240/120
65	G.E.	2200/440	Sq. Ca.	250

TRANSFORMERS 60 Cy.

1—1000 kva, Whse., 13,800—2300 V., 3 ph. New
1— 600 kva Standard, 13,800—2300 V., 3 ph.
3— 500 kva, G.E., 13,800—2300 V.
3— 333 kva, G.E., 13,800—2300 V.
3— 333 kva, G.E., 2400—480 V.
2— 300 kva, G.E., 4150—240 V., 3 ph., Pyr.
3— 200 kva, G.E., 2400—120/240 V.
3— 200 kva, Mol., 13,800—2300 V
3— 150 kva, Al. Ch. 2400—220 V.
3— 150 kva, Al. Ch., 440-220 V., dry, New
3— 100 kva, G.E., 2400—240/480, V New
3— 75 kva, Whse., 2400—240/480 V.

only partial listing

STEPHEN HALL & CO.
HARRY J. RICE, Pres.
625 ADAMS ST., HOBOKEN 2, N. J.

FOR SALE
18 NEW TURBINES

4 horizontal, 14 vertical, Westinghouse

Driving forced draft blowers—capacities ranging from 39000 to 56000 CFM and 16" to 24" pressure. Steam pressures 360 to 575#, back pressure 10#.

Will sell turbines separately if desired. *Price reasonable.*

Also—1—250 KW GE turbo generator unit, 3 phase, 60 cycle, 440 volt. Used one year.

G. M. DeROSE
2457 WOODWARD AVE.
408 DONOVAN BLDG.
DETROIT 1, MICH.

BOILERS

HI-PRESSURE

Complete stock from 10-2,000 hp.p
Nation's largest inventory. New & Used.

WABASH POWER EQUIPMENT
31 E. CONGRESS, CHICAGO 5, HA 7-4855

BOILER

200 H.P. Cleaverbrook, semi-automatic steam generator (1940). 150# working pressure. Rotary Burner #6 oil. Thermostatic control, feed water regulator, excellent condition. Sacrifice.

FS-4688, POWER
Class. Adv. Div., P.O. Box 12, N.Y. 36, N.Y.

3 NEW BOILERS

Available at fraction of new cost

BABCOCK & WILCOX single uptake controlled superheat marine type express boilers, 3 drums, with economizers.

Designed pressure	634 lbs.	Steam temperature	850°F
Operating pressure	550 lbs.	Furnace volume	1473 cu. ft.
Superheated steam	221,000 lbs./hr.	Total generating surface	9338 sq. ft.
Saturated steam	32,000 lbs./hr.	Superheater surface	1620 sq. ft.
Full power total	253,000 lbs./hr.	Economizer surface	3843 sq. ft.

NOTE: These boilers are new and complete. They are erected and ready for use and should therefore be considered only for such places as can be reached by water transportation.

HUGO NEU CORPORATION
45 Nassau St. Tel.: REctor 2-1334 New York 5, N. Y.

FOR SALE

Babcock and Wilcox package Type F-9 #57 integral furnace boiler designed for 250# pressure, 25,000 pounds per hour steaming capacity at continuous operation at 200# P.S.I. with 457 degree F. at superheater outlets.

Automatic control with complete complement of meters, gauges, recording instruments, etc. Operation on either oil or gas fuels.

W. R. SPRAGUE
Director of Purchases

AMERICAN HOIST & DERRICK COMPANY
63 S. Robert St., St. Paul 7, Minn.

20 & 36' x 5' Rotary Dryers
17 & 21' x 5' Ball Mills
426 HP B&W 3-drum WT Boilers
72x20—78x20—84x20 HRT Boilers
42" & 24" Belt Conveying Equipment
700 KW Generator dir. con. Diesel
210 KVA GE Generator D/C Unaflow Eng.
H. & P., 6719 Etzel, St. Louis 14, Mo.

WORLD'S LARGEST INVENTORY
NEW AND GUARANTEED REBUILT EQUIPMENT
MOTORS TRANSFORMERS GENERATORS DIESELS
WRITE, WIRE OR PHONE
ELECTRIC EQUIPMENT CO.
L. D. (Long Distance) 65
ROCHESTER 1, NEW YORK

FOR RATES OR INFORMATION

About Classified Advertising

Contact
THE McGRAW-HILL OFFICE NEAREST YOU

ATLANTA, 3
1301 Rhodes-Haverty Bldg. *JAckson 3-6551*
M. MILLER

BOSTON, 16
350 Park Square *HUbbard 2-7160*
H. J. SWEGER

CHICAGO, 11
520 No. Michigan Ave. *MOhawk 4-5800*
W. HIGGENS — J. BRENNAN

CINCINNATI, 37
1825 Yorktown Rd.
Swifton Village, Apt. 2 *REdwood 1-3238*
G. MILLER

CLEVELAND, 15
1510 Hanna Bldg. *SUperior 1-7000*
W. SULLIVAN

DALLAS, 2
Adolphus Tower Bldg., Main & Akard Sts. *RIverside 7-5117*
E. SCHIMER

DETROIT, 26
856 Penobscot Bldg. *WOodward 2-1793*
W. STONE

LOS ANGELES, 17
1125 W. 6th St. *MAdison 6-9351*
H. L. KEELER — D. McMILLAN

NEW YORK, 36
330 West 42 St. *LOngacre 4-3000*
S. HENRY—D. COSTER—R. LAWLESS—R. HATHAWAY

PHILADELPHIA, 3
17th & Sansom St. *RIttenhouse 6-0670*
H. BOZARTH

ST. LOUIS, 8
3615 Olive St. *JEfferson 5-4867*
W. HIGGENS

SAN FRANCISCO, 4
68 Post St. *DOuglas 2-4600*
W. WOOLSTON

80000#/HR. BOILER

ERIE CITY Type 1-W-T BENT WATER TUBE 3 drum 250 PSI W.P.; Built 1948; 8100 sq. ft. heating surface; 1370 sq. ft. water wall surface; steel encased; Rotograte spreader stoker; forced and induced draft fans; dust collectors; Thermix stack. Used only 2 years.

75000#/HR. BOILER

COMBUSTION ENGR. CO. 4 drum STIRLING Type BOILER 400 PSI W.P.; pulverized coal fired; forced and induced draft fans; superheater, waterwalls.

JUST PURCHASED

MODERN POWER PLANT

1875 KVA WORTHINGTON MOORE TURBINE 400 PSI, 700°F, Condensing, driving 2300 Volt CROCKER WHEELER GENERATOR 25000#/Hr. 450 PSI, 738°F, Coal Fired BOILER; includes all auxiliaries, controls, 25 Ton powerhouse crane and coal handling facilities.

WIRE — PHONE — WRITE

HEAT & POWER CO., INC.
60 E. 42nd St., New York 17, N. Y.
Murray Hill 7-5280
(Machinery & Equipment Merchants)

---

look for the WAGNER GREEN TAG CERTIFICATION

It's your guarantee that the equipment you buy is as perfect in workmanship as the day it left the factory.

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
200	Cr. Wh. b.b. (2)	CMC-81H	230	1150
175	Cr. Wh.	151-H	230	500
150	Whse.	SK-184	230	850
100	Reliance	651-T	550	1000/1800
100	Reliance	651-T	230	575/1150
100	Elliott b.b. T.E.	JH-FE	230	1150
75	Gen. Elec.	RF-16	230	450/900
60	G.E. TEFC b.b.	CD-135	230	1150
60	G.E.	CD-113	230	1150
50	Gen. Elec.	CD-95	230	1800
50	Star b.b.	SQ-92	230	680
50	G.E. (2)	CD-125	230	400/1200
40	G.E. (2)	CD-93	230	1750
30	Whse. (2)	SK-151	230	250/1000
25	L.A. TEFC b.b.	RNA	230	650

MOTOR-GENERATOR SETS

KW	Mfr.	Input V	Output V
300	Whse.*	2200/440 AC	600 DC
250	Cr. Wh.*	2300/4000 AC	250 DC
200	Whse.*	220/440 AC	55 DC
200	Gen. Elec.*	230/440 AC	125 DC
200	Whse.	2300 AC	250 DC
175	Gen. Elec.	220/440 AC	250 DC
125	Gen. Elec.*	2300/4000 AC	250 DC
100	G.E.*	2200/440 AC	125 DC
100	Whse.	220/440 AC	250 DC
75	G.E. converter	440 AC	250 DC
75	G.E.	220/440 AC	125 DC
60	Whse.	220/440 AC	250 DC
50	Gen. Elec.	220/440 AC	125 DC
50	Cr. Wh. b.b. (2)	220/440 AC	250 DC
30	G.E.	220/440 AC	125 DC

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
175	Cr. Wh. b.b.	CCD	250	1450
150	Whse.	SK-184	250	1150
150	Cr. Wh.	CCD	250	850
100	Allis Ch.	E	125	1200
100	Reliance	651-T	600	1200
75	Century	R-92	250	900
60	Allis Ch. (8)	E-140	250	1500
60	Ideal	D	125	1150
35	G.E.	RC-34	125/250	900

A. C. MOTORS — 60 CYCLE

HP	Mfr.	Type	Volts	Speed
600	G.E.	Slipring	2300	600
500	Whse.	Slipring	2200	450
450	Allis Ch.	Synch.	480	400
400	Whse. (2)	Synch.	2200	1800
400	Whse.	Sq. Cage	2200	514
400	Marathon (2)	Sq. Cage	2200	3000
400	Whse.	Sq. Cage	2300	900
400	G.E. (2)	Slipring	440	900
350	G.E.	Sq. Cage	2200	1800
350	Cont. b.b.	Slipring	2300	900
300	El. Mchy	Synch.	2200/440	360
300	Whse.	Synch.	440	1200
300	G.E.	Slipring	440	450
300	Allis Ch.	Sq. Cage	2200/440	720
250	G.E.	Slipring	440	1800
250	G.E.	Sq. Cage	2200/440	1200
250	Gen. Elec.	Sq. Cage	440	3600
250	G.E.	Slipring	220/440	720
250	Gen. Elec.	Synch.	220/440	450
250	Whse.	Slipring	440	1200
250	G.E.	Sq. Cage	2200	1800
250	Allis Ch.	Synch.	440	360
225	G.E.	Synch.	220/440	900
200	G.E. (2)	Sq. Cage	2200/440	1200
200	Whse. (2)	Slipring	2200	514
200	Reliance b.b.	Sq. Cage	220/440	1800
200	Allis Ch.	Slipring	440	450
200	Allis Ch.	Slipring	2200/440	720
200	Cr. Wh.	Sq. Cage	220/440	3600
200	Whse.	Sq. Cage	2200/440	900
200	G.E.	Sq. Cage	440	600
175	G.E. (2)	Synch.	220/440	720
150	El. Machy.	Synch.	220/440	360
150	G.E. (4)	Slipring	2200/440	600
150	G.E. (2)	Sq. Cage	2200/440	720
150	Cr. Wheeler	Sq. Cage	220/440	450
150	G.E.	Slip Ring	220/440	450
125	Whse. TEFC	Sq. Cage	2200/440	720
125	G.E. TEFC	Sq. Cage	2300	3600
125	Ideal	Slipring	4000/2200	900
350	Allis Ch.	Slipring	2200/600	600
100	Whse (2)	Sq. Cage	2200	900

TRANSFORMERS—6—167KVA Allis Ch. dry type, 1 ph. 60 cy. 2400/4160—240/480V., like new.

THOUSANDS OF MOTORS & GENERATORS IN STOCK

AC & DC . . . all sizes and types up to 1000 H.P. . . . all covered by the WAGNER guarantee.

Arthur Wagner Co. Certified
MO nroe 6-7409
1435 W. RANDOLPH ST
CHICAGO 7, ILLINOIS

FOR SALE

5—OIL CIRCUIT BREAKERS

Whse. late type, outdoor type, De-Ion Grid, T.P.S.T., Rated 161000 V., 1200 amps., 60 cy., 3 ph., Type GO-3, Interr. Duty 1,500,000 KVA.

Fully complete—Cond. like new.

Price and further inf. upon request.

PHILADELPHIA TRANSFORMER CO.
Box 566 Dalton, Pa.

HYDRO ELECTRIC GENERATING UNIT

Vertical type—585 HP—36 Ft. Hd.—150 CSF. Westinghouse Generator—500 KVA—2300 Volt —Direct Connected Exciter—Woodward Governor—Complete Switchboard—Leffel-F-Turbine. Location—Washington D.C. Reasonably Priced.

SORENSEN GOVERNOR SERVICE
264 Kossuth St, Bridgeport 8, Conn.

DIESEL ENGINES — POWER MACHINERY
100 KW to 1500 KW

Diesel Generator Sets • Stationary • Portable • Mobile Motors and Generators

A. G. SCHOONMAKER COMPANY, INC.

MAIN OFFICE: Box 516, Sausalito, Calif. Sausalito 1600
BRANCH: 50 Church St., N. Y. 7, N. Y. Digby 9-4350

2600 KW DIESEL POWER PLANT

Four each General Motors 12-567A Diesels, 1080 BHP, 720 RPM direct connected to 937.5 KVA, 659 KW Electric Machinery Manufacturing Company alternating current generators, 3 phase, 60 cycle, 480 volts.

These units being offered complete with all control and auxiliary equipment. Now in operation and may be inspected at any time. Will be available in April. Will sell separately.
BIDS INVITED

WAH CHANG MINING CORP.
137 Clarke St., Bishop, Calif. Ph. 8911

NEW STEAM JET AIR EVACTORS

Several in stock, large range in sizes, capacities from 1000 KW to 10,000 KW. Priced right.

CHARLES WEAVER
19701 James Couzens Hwy.
Detroit 35, Michigan
Phone: BRoadway 3-1901

COMPRESSOR DIRECTORY
World's Best Rebuilts

18 CFM	3500 PSI	Ing 30 New
138 CFM	100 PSI	7x7 Ingersoll ESI
268 CFM	500 PSI	10-4½x10 Ingersoll XOB
284 CFM	100 PSI	Chic. PE 50 HP
437 CFM	40 PSI	12x9 Ing ESI (New)
440 CFM	50 PSI	13x10 Worth—oil-less
552 CFM	100 PSI	13-8"x12 Ingersoll XRB
502 CFM	125 PSI	12x13 Chic T
676 CFM	100 PSI	15-9½x12 Ing XRB
593 CFM	100 PSI	13½-8x8 IR-XRE
868 CFM	100 PSI	17—10x12 CP-OCE
1270 CFM	40 PSI	19x13 Ing. ESI
1600 CFM	40 PSI	Fuller Rotary—Syn.
1723 CFM	110 PSI	140 lbs. st Ingersoll XPV
5748 CFM	50 PSI	28-29x21 IR—PREI

American
AIR COMPRESSOR CORP.
DELL AVE. & 47th ST.
NORTH BERGEN, N.J.
Telephone UNion 5-4848

FOR SALE
IRON FIREMAN ROTOSTOKERS

Two 150 horsepower, now in place under two 150 horsepower horizontal return tubular boilers. Stokers in excellent condition. Were shut down when we converted to oil. Stokers cost $7486.80 in 1946. Will sell for $1500. Write or call

HARTSVILLE OIL MILL
Hartsville, S.C.

FOR SALE—IMMEDIATE DELIVERY

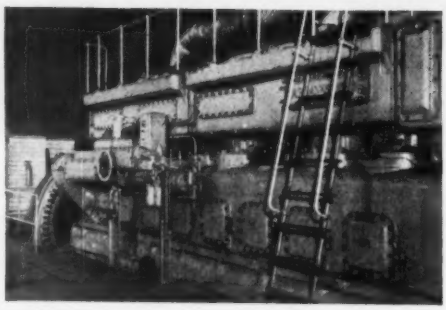
400 KW Terry non-condensing turbine, 325-400# PSI, 110-125# gauge back pressure, 3800 RPM, direct connected through reduction gear to a:

500 KVA—400 KW at 80% P.F., Allis Chalmers generator, 3 phase 60 cycle, 480 volts, 1200 RPM, excellent condition, complete installation equipped with direct connected exciter, switchboard with instruments and spare parts.

UTILITIES MACHINERY CORPORATION
1965 East Sixth St., Cleveland 14, Ohio

MODERN SLOW SPEED
DIESEL ELECTRIC GENERATING SET
OFFERED AT CONSIDERABLE SAVING

ALSO AVAILABLE
•
WORTHINGTON
BB5
100 KW
600 RPM
3/60/480
•
Other Sets from 20 KW to 1200 KW



COMPLETE WITH ALL AUXILIARIES
—
Other Sets from 20 KW to 1200 KW

FAIRBANKS MORSE MODEL 33E16
1125 KW 300 RPM 3/60/480V

NATIONAL METAL & STEEL CORP.
1251 NEW DOCK STREET, TERMINAL ISLAND (LOS ANGELES HARBOR), CALIF.
CALL LOS ANGELES NEvada 6-9871
DIESEL DIVISION

WANTED — BOILER

Late model oil fired pkg type water tube boiler 15000 to 30000 lbs. per hour, 200# s.w.p. Boiler must be A.S.M.E. and Mass. Std. approved.

W-4490, POWER
CLASS. ADV. DIV.
P.O. BOX 12, NEW YORK 36, N Y.

WANTED

2 steam turbine generator sets—2300/3/60. Approx 300 KVA each, 150 to 175 pounds pressure and 10 pounds back pressure.

300 H.P. 550/3/60 slip ring motor, 600 speed preferred.

CRUSHERS: 3 foot or 4 foot short head or standard cone crusher—also 24" or 36" or larger jaw crusher.

500 H.P. 4160/3/60/1800—Ball bearing slip ring preferred would consider squirrel cage with automatic reduced voltage starter.

SOUL CLINIC, INC., Calgary, Can.

DIESEL GENERATOR SETS

2—McIntosh-Seymour (Alco) 950 HP 8 cyl. 225 RPM, 875 KVA Westinghouse 3 phase, 25 or 60 cycle alternators. 20 KW exciters.

1—McIntosh-Seymour (Alco) 600 HP 5 cyl. 225 RPM, 500 KVA General Electric 3 phase, 25 or 60 cycle alternator. 15 KW exciter.

Complete plant installation with all accessories. Priced attractively.
With or without generators.

WHISLER EQUIPMENT CO.
Affiliated with
MISSISSIPPI VALLEY EQIUP. CO.
611 Olive St. • St. Louis 1, Mo.

IN STOCK—LOWEST PRICES

POWER TOGGLE SWITCH—Cutler Hammer 8781K3 SPST 175 Amps. We've sold thousands of these to the field. BUY NOW from the direct source and save ea. $1.95

BALLAST RESISTOR (Vitrohm)—1 Ohm, 24 Amps. Consists of 2.5 Ohm resistors in series in a metal cage. Regular price on these $20. Few hundred in stock at $2.50 each.

ELECTROLYTIC CONDENSER—4000 Mfd. 50 WVDC Cornell Dubillier. List Price $12.50. In original factory pack. We sell far below cost. With mtg. bracket $2.50 ea.

RHEOSTATS—50 Watts (Ohmite 22.500 or 150 Ohms $1.00 ea. 75 Watts (Ohmite) 15 Ohms $1.25 ea. 100 Watts (Ohmite) 15, 25, or 100 Ohms $1.75 Ea.

RECTIFIER POWER SUPPLIES — TO YOUR SPECS. (We list several stock models) Cat. #FWB-10 Input 110 V. 60 Cy. 1 Ph. (Bench Type) Output 0-20 VDC 10 Amperes continuous 24 hr. op. Housed in corrosion resistant cabinet, fully metered, fused, protected with provision for 20% overload.

Cat. #FWB-20 Same ratings except 0-10 Volts 20 Amps. Either Model $85.00 FOB NY, quotations by return phone, mail, or wire. State requirements. 1% regulation, ripple, or filter avail. Component replacement parts for your power supplies. Fast delivery. Lowest prices. **SINCE 1945.**

GREENWICH SALES CO.
50 Cortlandt St., N.Y. 7, N.Y., Digby 9-3813

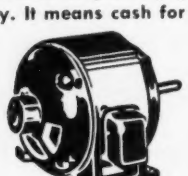
WANTED

Complete power plants, turbo generators, Boilers, Condensers, Engine generators, Processing Plants and equipment.

PAUL OBERMAN
1910 Delmar St. Louis, Mo.

CASH FOR SURPLUS NEW MOTORS

Ajax pays hard cash for your new surplus motors, controls and transformers. Send your list of new surplus equipment today. It means cash for you.



NEW MOTORS AVAILABLE
We have over 5,000 new motors—IN STOCK—from ¼ HP to 200 HP. Save Money.

Write, wire or phone collect!

AJAX ELECTRIC MOTOR CORP.
P.O. Box 262 • Rochester, N.Y.
Long Distance Phone LD. 132

NEW AIR EJECTORS

Either C. H. Wheeler or Westinghouse. Type 4H55. Capacity 12 lbs. air/hr. Operating steam pressure 275 lbs. gauge.

NEW SURPLUS M.G. SETS

(2) 4-bearing ball-bearing self-ventilated drip-proof. MOTORS: 180 HP—440/3/60—328 amps—1200 RPM—synchronous. GENERATORS: 128 KW—120 volts—1070 amps—type CD—size 52H—42°C rise. Drip-proof enclosed marine units. Mfg. by Crocker-Wheeler. All set on common base.

SUBMARINE MOTORS

(1) G.E.—1375 HP at 415 volts DC—2-bearing ball-bearing—1375 RPM.

THE BOSTON METALS CO.
313 E. BALTIMORE STREET
Baltimore 2, Md.—Lexington 9-1900

AIR COMPRESSOR

Ing.-Rand 14½" x 14½" x 10", Type XRE, low press. 35#, 1370 CFM, 1 stage, 360 RPM, W/150 H.P. Whse. sync. motor 3 ph., 440 V, shaft mounted, new 1952, fully complete.

Further inf. upon request.

PHILADELPHIA TRANSFORMER CO.
Box 566 • Dalton, Pa.

FAIRBANKS MORSE DIESEL

2000 HP 10 cylinder, O.P. model #38E 8 ⅛, 850 rpm, modern unit. Ready to ship.

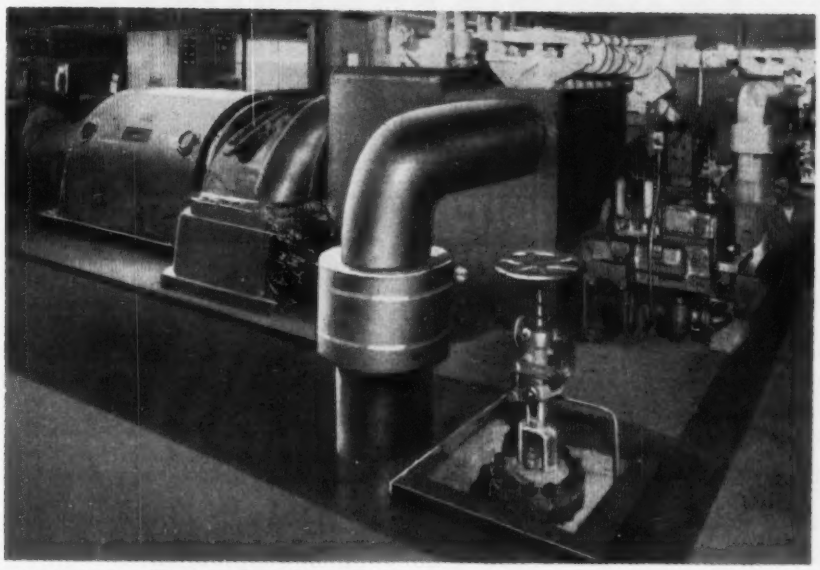
ALJON ELEC. DIESEL CO.
904 Pacific St., Bklyn. 38, N. Y.

WANTED
300 HP USED MOTOR

900 R.P.M. 220 volts 60 cycles, 3 phase squirrel cage or slip ring, with starting controls, automatic or manual with low voltage starting.

W-4660, POWER
Class. Adv. Div., P. O. Box 12, N. Y. 36, N. Y.

3125 KVA AUTOMATIC EXTRACTION-CONDENSING



The above Worthington-Crocker Wheeler Turbine-Generator is modern unit. Turbine #5211, 250/300 PSIG, 750°FTT (good for 400# with changes) controlled extraction 15 to 50#, 30,000#/hr., 80% throttle flow extraction. Crocker-Wheeler Generator #892503, 3/60/13,800 V. with shaft-driven Exciter, Surface Condenser with all auxiliaries.

CHARLES WEAVER

19701 James Couzens Hwy. Tel: BRoadway 3-1901 Detroit 35, Michigan

---

FOR SALE

SKINNER-ENGINE and 250 KW GENERATOR

CURRENT—440—3 P 60 Cy.
WITH CONTROLS

REASON FOR SELLING
TO SMALL

WAHLFELD MFG. CO.
PEORIA — ILLINOIS

—TRANSFORMERS—

BOUGHT AND SOLD

We carry a large stock of rebuilt and guaranteed transformers, and invite your inquiries.

Custom-built transformers and coils manufactured to your specifications.

Expert Repair Service—all makes and sizes of transformers rewound, repaired and redesigned. Ask for our price schedule.

THE ELECTRIC SERVICE CO., INC.
5318 Hetzel St. Cincinnati 27, Ohio
40 Years' Dependable Service

Sales—GENERATORS—Rentals
*100 KW G.M. 3/60/120/208 +Diesel
75 KW G.M. 3/60/120/208 +Diesel
60 KW G.M. 3/60/127/220 +Diesel
25 KW I-H 1/60/120/240 Diesel
*75 KW Wauk. 3/60/120/208 +Gasoline
35 KW Onan 3/60/120/208 Gasoline
*New +440 Volt
DIESEL MOTORS CO.
Rte. 25, Middle Island, L.I., N.Y. YAphank 4-6500

FOR SALE
1 STRONG-SCOTT PULVERIZER
Size B12-LH, equipped with a B8 blower.
Serial #51123, S.O. 613036 with extra parts.
GLOVERSVILLE KNITTING CO.
Gloversville, New York

PACKAGE BOILER

Unusual Opportunity—Sacrifice, Orr & Sembower Powermaster, 80 H.P., High Pressure, #6 Oil, Completely Automatic, USED 3 MONTHS. Owner.

THE LONG ISLAND WASTE CO., INC.
37 Moultrie St., Brooklyn 22, New York
EV 9-6555

3500 KW MG SETS

5—3500 KW, 3 Unit, Allis-Chalmers, Motor Generator Sets. Each consisting of:

2—1750 KW, 250/350 Volts parallel, 500/700 Volts series, 514 RPM, 500 Amp, Type HCC, rated continuous at 40 Deg. C. Allis-Chalmers DC Generators with Class B Insulation, separately excited, direct connected in the center to:

1—5000 HP, 3730 KW, 13800 Volts (6900 Volts), 3 Phase, 60 Cycle, 514 RPM, 162 Amps, Allis-Chalmers, Synchronous Motor with Class B Insulation, rated continuous at 40 Deg. C. Rise.

The Motor Generator Set is equipped with a 40 KW 514 RPM, 250 Volt, DC Exciter and a 10 KW, 514 RPM, 250 Volt, Allis-Chalmers DC Exciter.

All mounted on a structural steel base approximately 27' long x 11' wide.

These Units are of the very latest type and design—condition excellent—were used only a short time—AC and DC Switchgear available.

For any additional information and price, please contact one of the following dealers closest to you:

DUQUESNE ELECTRIC & MFG. CO., 6428 Hamilton Avenue, Pittsburgh 6, Pa.
MOOREHEAD ELECTRICAL MACHINERY CO., 120 Noblestown Rd., Oakdale (Pittsburgh District), Pennsylvania.
BRAZOS ENGINEERING CO., INC., P.O. Box 9114, Houston, Texas
T. B. MacCABE COMPANY, 4300 Clarissa Street, Philadelphia 40, Penna.

ADVERTISERS' INDEX

This index is a service to readers. Every effort is made to maintain its accuracy, but POWER cannot assume responsibility for errors or omissions. When a star appears after the name, the advertisement does not appear in this issue but appeared in an issue within the previous three months.

Air Preheater Corp. 245
Airetool Mfg. Co. 192
Alco Products, Inc. 150-151
Alken-Murray Corp. ..... *
Allen-Sherman-Hoff Co. ..... *
Allgemeine Elecktricitats-Gesellschaft ..... Second Cover
Allis-Chalmers Mfg. Co. 33-34, 38-39
Allpax Company, Inc. 230
Aluminum Company of America ..... *
American Blower Corp. 46-47
American Gilsonite Co. ..... *
American Pulverizer Co. 233
Ames Iron Works, Inc. ..... *
Anchor Packing Co. 241
Arkansas Fuel Oil Co. 163
Armstrong Cork Company ..... *
Armstrong Machine Works 143
Atomics International, Div. of North American Aviation, Inc. 237
Automatic Switch Company ..... *

Babbitt Steam Specialty Co. 226
Babcock & Wilcox Co. 6-7, 171
Babcock & Wilcox Co. (Refractories Div.) ..... *
Babcock & Wilcox Co. (Tubular Products Div.) 267
Babcock & Wilcox Co. (Tubular Products Div., Fittings Dept.) ..... *
Badger Mfg. Co. ..... *
Bailey Meter Co. 12-13
Baldwin-Hill Co. ..... *
Baltimore & Ohio Railroad 195
Bell & Gossett Co. 193
Belmont Packing & Rubber Co. ..... *
Biddle Co., James G. 194
Bigelow Co. ..... *
Bingham Pump Co. 204
Bituminous Coal Institute 271
Black, Sivalls & Bryson, Inc. 173
Blaw-Knox Co. Power Piping & Sprinkler Div. ..... *
Boiler Tube Co. of America ..... *
Bonney Forge & Tool Works 250
Bridgeport Brass Co. 50
Brooks Rotameter Co. 286
Brown Boveri Corp. 274
Buell Engineering Co. 182
Buffalo Forge Co. 28-29
Buffalo Pumps, Inc. 277
Burgess-Manning Co. Penn Instruments Div. ..... *
Bussmann Mfg. Co. 70-71
Byers Company, A. M. ..... *
Byron Jackson Pumps, Inc. ..... *

Canton Stoker Corp. ..... *
Cash Co., A. W. 57
Catawissa Valve & Fittings Co. ..... *
Caterpillar Tractor Co. 177
Celanese Corp. of America (Chemical Div.) ..... *
Chapman Valve Mfg. Co. 278
Chase Brass & Copper Co. ..... *
Chesapeake & Ohio Railway ..... *
Chesterton Co., A. W. 184
Chicago Pneumatic Tool Co. ..... *
Chicago-Wilcox Mfg. Co. 226
Childers Mfg. Co. 284
Cities Service Oil Co. 163
Clarage Fan Co. 239
Clark Bros. Co. 229
Cleaver-Brooks Co. (Boiler Div.) ..... *
Cleveland Controls ..... *
Cochrane Corporation 225
Combustion Engineering, Inc. 16-17
Condenser Service & Engrg. Co. 248
Continental Electric Equipment Co. ..... *
Cook's Sons, Inc., Adam 218
Cooper-Bessemer Corp. ..... *
Copes-Vulcan Div., Blaw-Knox Company 14-15
Coppus Engineering Corp. 183
Corning Glass Works ..... *
Crane Company 4, 161
Crane Packing Company 249
Crawford Fitting Co. ..... *
Curtiss-Wright Co. 281
Cyclotherm Div., National-U.S. Radiator Corp. ..... *

Darling Valve & Mfg. Co. 190
Deady Chemical Co. 254
Dearborn Chemical Co. 263
DeLaval Steam Turbine Co. 2, 231
Deming Company ..... *
Detroit Controls Corp. 178
Detroit Stoker Co. 62
Diamond Power Specialty Corp. 8-9
Dodge Mfg. Corp. 234, 235
Dow Chemical Co. 56
Dow Corning Corp. 266
Dowell, Inc. ..... *
Dravo Corporation 268
Dwyer Mfg. Co., F. W. ..... *

Eagle-Picher Co. 276
Edison, Inc., Thomas A. 258
Edward Valves, Inc. 185
Electric Cord Company ..... *
Electric Machinery Mfg. Co. 54-55
Electric Storage Battery Co., Exide Industrial Div. 223
Elgin Softener Corp. ..... *
Elliott Company 10-11, 139, 240
Engineer Company 228
Equipto Div. of Aurora Equip. Co. 282
Erico Products, Inc. 196
Erie City Iron Works ..... *

Fairbanks Co. 246
Fisher Governor Co. 243
Flexible Steel Lacing Co. ..... *
Flexitallic Gasket Co. ..... *
Fluor Products Co. ..... *
Foster Engineering Co. ..... *
Foster Wheeler Corp. 32, 59, 201
Foxboro Company 155
Frick Company 208
Fuller Company ..... *

Garlock Packing Company 20-21
Gates Rubber Co. ..... *
General Electric Co. (Apparatus Dept.) 252-253
General Electric Co. (Circuit Protective Devices Dept.) ..... *
General Motors Corp., Electro Motive Div. ..... *
Goodrich Industrial Products Co., B. F. 298
Goulds Pumps, Inc. ..... *
Graver Tank & Mfg. Co., Inc. 53
Green Fire Brick Co., A. P. 175
Grinnell Company ..... Third Cover
Gulf Oil Corp. 24-25

Hagan Chemicals & Controls, Inc. ..... *
Hall Laboratories 209
Harbison Walker Refractories Co. ..... *
Harco Corp. ..... *
Haskins-Turner Co. ..... *
Hays Corporation 273
Hewitt-Robins 244
Heyl & Patterson, Inc. 159
Hilliard Corp. 238
Hoffman Specialty Mfg. Corp. ..... *
Hoke Incorporated 297

I-T-E Circuit Breaker Co. (Switchgear Div.) 256
Illinois Water Treatment Co. 197
Infilco Inc. ..... *
Ingersoll-Rand Co. 41, 199
International Nickel Co., Inc. 58
Iron Fireman Mfg. Co. ..... *
Irving Subway Grating Co., Inc. 210

Jeffrey Mfg. Co. ..... *
Jenkins Bros. 147
Jerguson Gage & Valve Co. 224
Johns-Manville 157, 259
Johnson Service Co. ..... *
Jones & Laughlin Steel Corp. 227
Joy Mfg. Company ..... *

Kaiser Aluminum & Chemical Sales, Inc. 255
Keasbey & Mattison Co. 279
Keeler Company, E. ..... *
Kennedy-Van Saun Mfg. & Engrg. Corp. ..... *
Kewanee Boiler Div. 275
Kieley & Mueller, Inc. ..... *
Kirk & Blum Mfg. Co. 220
Klinger, Ltd., Richard 108
Koppers Co., Inc. (Aeromaster Fans) ..... *
Koppers Co., Inc. (Coupling Dept.) 283
Koppers Co., Inc. (Industrial Gas Cleaning Dept.) ..... *
Koppers Co., Inc. (Piston Ring & Seal Dept.) 217
Kuljian Corporation ..... *

L A Water Softener Company 242
Laclede Stoker Co. ..... *
Ladish Company ..... *
Layne & Bowler Pump Co. ..... *
Leeds & Northrup Company 60
Leslie Company ..... *
Link-Belt Company 1
Lockett & Company, Ltd., A. M. ..... *
Lunkenheimer Company ..... *

Manning, Maxwell & Moore, Inc. 40, 181, 207, 221
Marley Company 165
Marsh Instrument Co. ..... *
Maryland Shipbuilding & Drydock Co. ..... *
Mason-Neilan Regulator Co. 18-19
McDonnell & Miller, Inc. ..... *
McGraw-Hill Book Co. 224
McNally-Pittsburgh Mfg. Corp. 186
Mercoid Corp. 226
Midcontinent Tube Service, Inc. 287
Midwest Piping Co., Inc. 179
Minneapolis-Honeywell Regulator Co., Industrial Div. 22-23
Minnesota Mining & Mfg. Co. ..... *
Monsanto Chemical Co., Organic Chemicals Div. 145
Morton Salt Co. ..... *
Murray Iron Works Co. 180
Murray Mfg. Co., D. J. 210

National Airoil Burner Co., Inc. 174
National Aluminate Corp. 149
National Tube Div. 260
Niagara Blower Co. 218
Nicholson & Co., W. H. 269
Nordberg Mfg. Co. 286
Norton Company 167

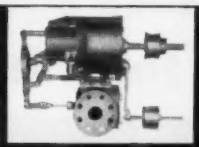
Ohio Brass Co. ..... *
Ohio Injector Co. 65
Okonite Co. 265

Panellit, Inc. ..... *
Parker Appliance Co. ..... *
Peabody Engineering Corp. 200
Peerless Pump Div., Food Machy. & Chemical Corp. 261
Pennsylvania Flexible Metallic Tubing Co. 63
Pennsylvania Pump & Compressor Co. ..... *
Permutit Company ..... Back Cover
Perolin Co., Inc. 247
Philadelphia Gear Works, Inc. 35
Phoenix Mfg. Co. (Flange & Forging Div.) 272
Pittsburgh Piping & Equipment Co. 72
Potts Co., Horace T. ..... *
Powell Co., Wm. 168
Powers Regulator Co. 282
Pratt Company, Henry ..... *
Preferred Utilities Mfg. Corp. 232
Pritchard & Co., J. F. ..... *

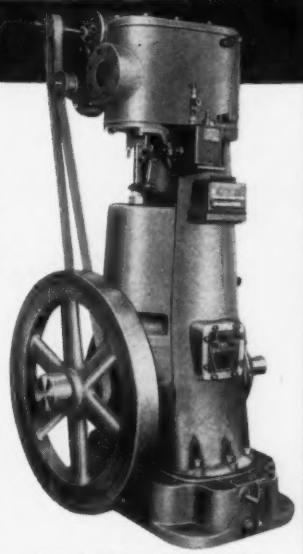
Raybestos-Manhattan, Inc. Manhattan Rubber Div. 44-45
Raybestos-Manhattan, Inc. Packing Div. ..... *
Reliance Gauge Column Co. 214
Republic Flow Meters Co. 66-67
Republic Steel Corp. 30-31
Research-Cottrell, Inc. 42-43
Revere Copper & Brass, Inc. ..... *
Ric-Wil Incorporated ..... *
Ridge Tool Company 26-27
Riley Stoker Corporation 106-107
Ross Heat Exchanger Div. 264
Roto Div. of Elliott Co. 198

Sarco Company 153
Sargent & Lundy Engineers 61
Scam Instrument Corp. ..... *
Schaub Engrg. Co., Fred H. ..... *
Scovill Mfg. Co. 188
Sinclair Refining Co. 211
Smith Company, S. Morgan 280
Smith Corporation, A. O. ..... *
Socony Mobil Oil Co., Inc. 141
Solar Aircraft Co. 64
Spence Engineering Co. 257
Standard Oil Co. of Indiana 191
Standard Steel Spring Div., Rockwell Spring & Axle Co. ..... *
Stephens-Adamson Mfg. Co. ..... *
Stickle Steam Specialties Co. 212

STOP WASTING STEAM



Type EN Governor Fully enclosed, Self-lubricated



Let Troy Steam Engines and Generators produce dollar-saving "BY-PRODUCT POWER" from steam available for processing or heating. You can use this low-cost power for many operations in your plant, even against high back pressures!

Use it for—

Generating Electrical Power

Mechanically Driving stokers, pumps, fans, compressors and other equipment.

It will pay you to investigate this source of cheaper power. TROY Equipment can be your key to COST REDUCTION! *Send for Booklet #306.*

Type E. Engine, 12.5 to 100 HP.

TROY TROY Engine & Machine Co.

703 Parsons Street Troy, Pennsylvania

O-RINGS are a valve's best friend

Drippy, leaky valves are just not socially acceptable . . . so, we designed the new Hoke bar stock needle valve with an O-ring stem seal—to give it the right start in life. Result—a seal that will pass a helium leak test . . . no packing adjustments . . . no friction even at high pressure. Self-aligning spindle shuts off tight. For instrument panel, test stand, hydraulic or pneumatic service. In carbon, chrome or stainless steel and brass, for ⅛" to ½" pipe sizes. Panel mounted, too, if needed.

We've got a brand new wall chart as well as catalog information—Both yours for the asking.

HOKE HOKE INCORPORATED

Fluid Control Specialists

190 S. DEAN ST., ENGLEWOOD, N. J.

Stillwater Clay Products Co.
Stillwater Conduit Div. •
Stock Equipment Co. 133
Stone & Webster Engrg. Co. 187
Stow Manufacturing Co. •
Sylvania Electric Products, Inc., Atomic Energy Div. 270

Taylor Instrument Companies 189
Taylor & Company, W. A. 212
Terry Steam Turbine Co. 215
Texas Company •
Titusville Iron Works Co. Div. of Struthers-Wells Corp. 222
Troy Engine & Machine Co. 297
Tube-Turns, Inc. 205-206

Union Asbestos & Rubber Co. •
Union Iron Works •
United States Gauge 236
United States Rubber Co. (Mechanical Div.) 251
United States Steel Corp. •
Universal Atlas Cement Co. •

Vapor Heating Corp. •
Viking Pump Co. •
Virginia Gear & Machine Corp. 35
Vogt Machine Co., Henry 213

W-S Fittings Div. H. K. Porter Company, Inc. 216
W-K-M Div. of ACF Industries 219
Wallace & Tiernan, Inc. 176
Walworth Company 48-49
Warren Pumps, Inc. •
Western Chemical Co. •
Western Precipitation Corp. •
Westinghouse Electric Corp. 68, 202-203
Westinghouse Electric Corp. (Sturtevant Div.) •
Wheeler Mfg. Co., C. H. •
Where to Buy 287
Wickes Boiler Co. •
Wiedeke Co., Gustav 208
Wilson, Inc., Thomas C. •
Wing Mfg. Co., L. J. •
Worthington Corp. 51-52
Wright-Austin Co. •

Yarnall-Waring Company 36-37, 135

Zallea Brothers 262
Ziegler & Co., G. S. •

Professional Services 287

CLASSIFIED ADVERTISING

F. J. Eberle, Business Mgr.

EMPLOYMENT OPPORTUNITIES 288

EQUIPMENT
(Used or Surplus New)
For Sale 289-295

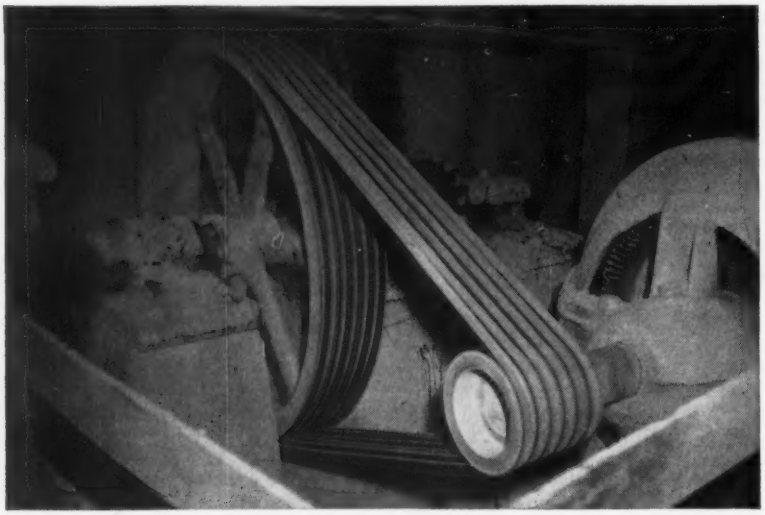
WANTED
Equipment 294

ADVERTISERS INDEX
Ajax Electric Motor Corp. 294
Aljon Electric Diesel Co. 294
American Air Compressor Corp. 293
American Hoist & Derrick Co. 292
American Marietta Co. 288
Bechtel Corp. 288
Belyea Co., Inc. 290
Benson-Wilimzig Co., Inc. 290
Boston Metals Co., Inc. 294
Brew-Woltman & Co., Inc. 290
Chicago Electric Co. 289
DeRose, G. M. 292
Diesel Motors Co. 295
Duquesne Electric & Manufacturing Co. 295
Ebasco Services, Inc. 289
Electric Equipment Co. 292
Electric Service Co., Inc. 295
Ellis Co., A. Lee 290
Foster Co., L. B. 290
Gloversville Knitting Co. 295
Greenwich Sales Co. 294
H & P Machinery Co. 292
Hall & Co., Stephen 292
Hartsville Oil Mill 293
Heat & Power Co., Inc. 293
Hemphill & Co., Inc. 290
Howe Brothers 290
Long Island Waste Co., Inc., The 296
Merck & Co., Inc. 288
National Metal & Steel Corp. 294
Neu Corp., Hugo 292
Oberman, Paul 294
Philadelphia Transformer Co. 289, 293, 294
Rocky Bay Co. 289
Schoonmaker Co., Inc., A. G. 293
Sorenson Governor Service 293
Soul Clinic Inc. 294
Utilities Machinery Corp. 293
Wabash Power Equipment Co. 292
Wagner Co., Arthur 293
Wah Chang Mining Corp. 293
Wahlfield Mfg. Co. 296
Weaver, Charles 291, 293, 295
Whisler Equipment Co. 294

B. F. Goodrich distributors solved these costly problems—can they help you?

Rubber "mule" saves $1500. The circular saws in this lumber mill used to be run by a gear mechanism. But the steel gears wore out too soon, took high overtime to repair and replace. A mule drive, using a B. F. Goodrich Highflex transmission belt, was suggested by a distributor. The change saved $1500 maintenance costs in the first month alone.

Saves cost of freight elevator. Problem in this warehouse was moving refrigerators upstairs for storage, then down again for shipment. A $19,000 freight elevator seemed to be the only answer until a distributor suggested a B. F. Goodrich Ribflex conveyor belt. While it cost much less, the "rubber elevator" works so well, it's giving everything the owners expected in the way of service.



Belt costs cut $100 a month. Six ordinary V belts weren't strong enough to turn a ball mill loaded with 22 tons of steel balls, water and ore. The belts lasted only 5 or 6 weeks. But there wasn't space to expand, and redesigning the drive would cost $800. Then B. F. Goodrich Grommet V belts were tried. They lasted not six weeks but six months, saved $100 a month in belt costs, plus the cost of rebuilding the drive.

These savings were made because a B. F. Goodrich distributor studied the problem, then selected the type, size and grade of belt that was right for the job.

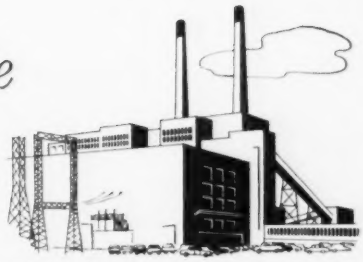
If you have "problem" installations in your plant, remember that B. F. Goodrich distributors are "specialists in rubber", ready to put their training and experience to work for you. By making a B. F. Goodrich distributor your *chief* supplier for rubber products, you not only get top quality products, but you also save buying time, have a dependable source of supply, and get fast delivery on most items from local stocks. *B. F. Goodrich Industrial Products Co., Dept. M-904, Akron 18, Ohio.*

Grommet—T. M. The B. F. Goodrich Co.

B.F.Goodrich

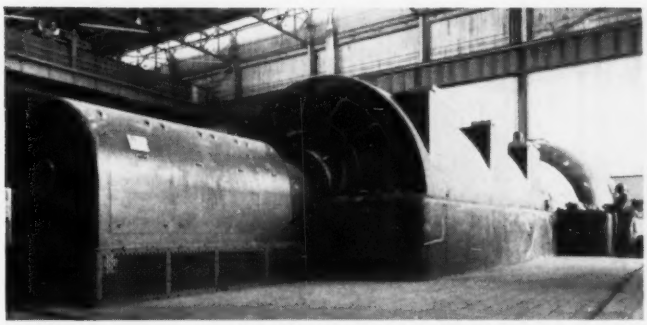
INDUSTRIAL PRODUCTS

Grinnell provides *complete fire protection* for vital areas at Detroit Edison Company

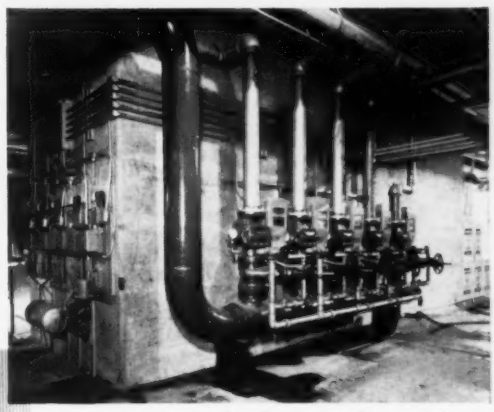


Pictures below taken at River Rouge Power Plant of Detroit Edison Company.

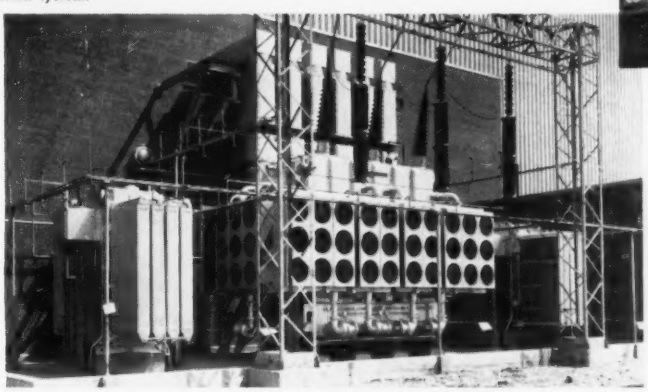
GRINNELL MULSIFYRE SYSTEM FOR EXTINGUISHING OIL FIRES



Grinnell Mulsifyre System provides efficient protection for hazardous areas of turbine lubrication system.



Automatic control valves for various fire protection systems throughout station.

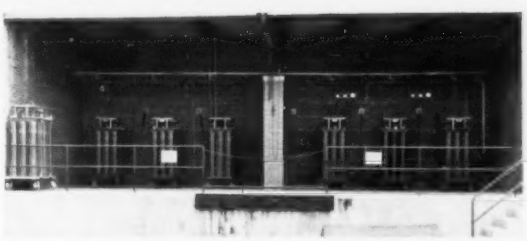


Around-the-clock protection for world's largest capacity (315,000 kva) generator transformer provided by Grinnell Mulsifyre System.

Complete extinguishment of fires within areas protected by Grinnell Mulsifyre is usually obtained in a matter of seconds after water discharge starts. Case histories prove that Mulsifyre projectors are effective wherever the danger of fire in medium or heavy oils can be limited to a definite area. In these oils the surface emulsion remains to give after-protection against flashback. Detailed information on Grinnell Mulsifyre will be sent on request.

GRINNELL PROTECTOSPRAY FOR COOLING AGAINST FIRE EXPOSURE

Flammable gases having wide explosive limits require protection against input heat when stored under pressure to prevent bursting of the containers. Hydrogen gas, with explosive limts of 4 to 75 percent when mixed with air, requires protective cooling whenever and wherever its container faces the danger of exposure to possible fire or heat from fire.



Grinnell ProtectoSpray System stands guard at hydrogen cylinder storage dock.

GRINNELL WHENEVER FIRE PROTECTION IS INVOLVED

Grinnell Company, Inc., Providence, Rhode Island • Branch offices in Principal Cities

HOW TO SELECT WATER-CONDITIONING EQUIPMENT (NO. 2 OF A SERIES)

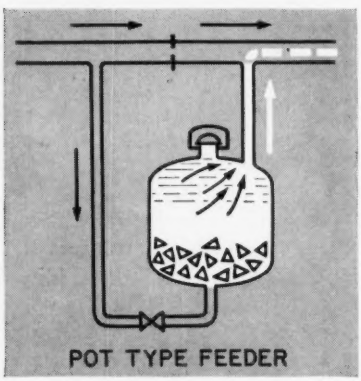
Chemical Feeders

Practically all water-treatment systems include addition of chemicals for one or more purposes: as coagulants to adsorb color, organic matter, oil and turbidity; to raise or lower pH; for lime softening; to inhibit corrosion; to kill bacteria; to adsorb tastes and odors.

The method of feeding the chemicals depends on the kinds used and on the volume, accuracy and proportions required. In general, solution feeders are used for smaller dosages and chemicals which can't be fed dry; dry feeders for large dosages. Here are some of the most-used types of feeders:

Pot type feeders

These are used for slow-dissolving chemicals in crystal or lump form (alums, sal soda, etc.) or special briquets. The chemical is placed in the feeding pot where it is dissolved by by-pass water flowing from the high-pressure side of an orifice to the



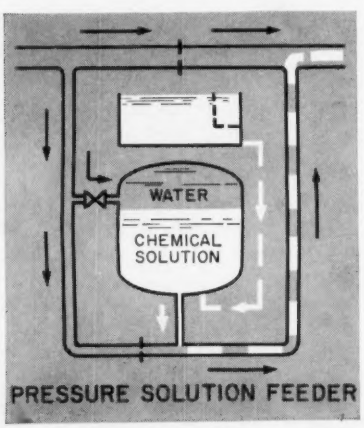
POT TYPE FEEDER

low-pressure side. Since this flow is proportional to the main flow, the amount of chemical fed is proportional. Variations in amount and solubility of the chemical can, however, affect the feed rate.

Pressure solution feeders

These allow use of lower cost chemicals (aluminum sulfate, soda ash, etc.) than pot type feeders and provide more accurate control. The chemical is dissolved in the open tank. When needed, the solution is charged into the bottom of the pressure tank, and the displaced water, being lighter, flows out the top to waste. A sight glass float shows the level of the chemical solution in the pressure tank. When on the line, the feeder feeds from the bottom.

Note that solution feed is into a by-pass circuit instead of directly into the raw water line. This eliminates a long vertical run of undiluted solution which, because of its greater weight over the water in the circuit, could affect proportional feeding accuracy.



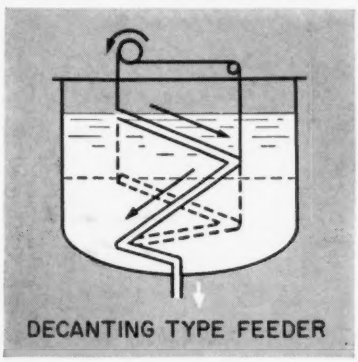
PRESSURE SOLUTION FEEDER

Gravity orifice feeders

A solution of known concentration flows through an adjustable orifice under constant head to provide the desired rate. For intermittent feed, a solenoid valve on the orifice discharge line is operated simultaneously with a raw water pump. Low in cost but limited to constant water flow rates and clear solutions that will not clog the orifice.

Decanting type feeders

This type is known as Permutit Electro-Chemical Feeder. A swing draw-off pipe is lowered at a speed that draws off solution at the desired rate. Feeds practically any type of solution or slurry used for water treatment.



DECANTING TYPE FEEDER

For proportional feeding, a water meter operates a timer that starts the feeder motor which lowers the draw-off pipe for a pre-set period. The timer controlling the lowering rate is easily adjustable allowing wide flexibility and accurate control. Rugged construction. Available with mixing propeller and with cover and dust evacuator.

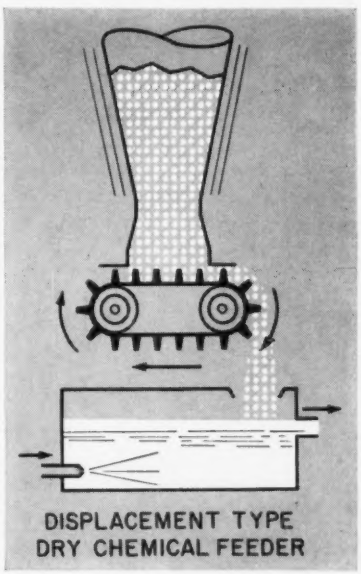
Reciprocating pumps

Pumps with adjustable length of stroke are widely used as feeders . . . generally operated by a meter and timer. Since volumes fed per stroke are uniform, feeding is accurately controlled.

A duplex or double pump feeds one solution to 2 or more points . . . or 2 or more solutions to the same or different points . . . in adjustable proportions.

Dry chemical feeders

A displacement type dry feeder eliminates batch weighing or measuring of dry chemicals and delivers a constant flow of accurately measured amounts of dry chemical (by volume) to a mixing chamber through which water flows at a sufficient rate for good mixing and to prevent settling.



DISPLACEMENT TYPE DRY CHEMICAL FEEDER

The chemical is discharged from a vibrated hopper onto a moving belt with lugs which "slice" off equal, exact volumes of the dry material. The belt speed is adjustable to deliver from 0 to hundreds of lbs. per hour by simple setting of a stepless speed changer. Adjustable while feeder is running, if required.

The feeder can be designed for constant rate feed or, with a meter and timer, for proportional feeding. Feeds practically any type of non-deliquescent dry powder or granules. Can be equipped with counter to show cumulative amount of chemicals fed.

• • • •

For complete details on feeders or other types of water-conditioning equipment, write: The Permutit Company, Dept. P-4, 330 West 42nd Street, New York 36, N. Y. or Permutit Company of Canada, Ltd., Toronto 1, Ont.

PERMUTIT®

rhymes with "compute it"

Water Conditioning

Ion Exchange • Industrial Waste Treatment